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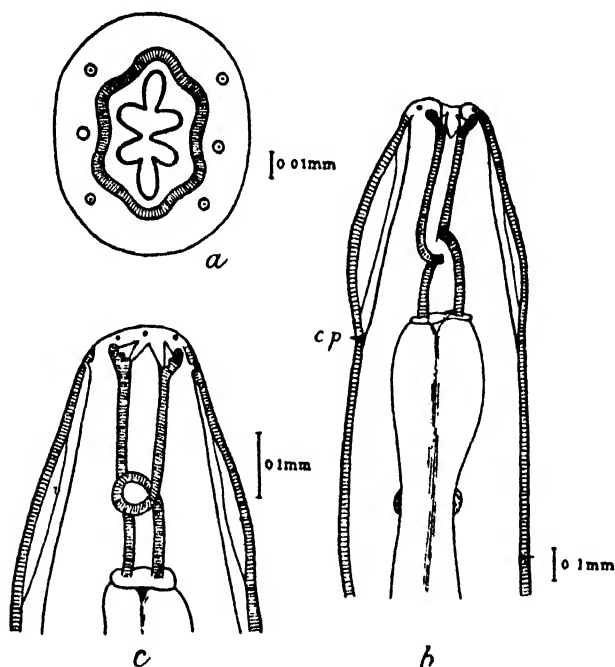
A NEW SPECIES OF THE NEMATODE GENUS *STREPTOPHARAGUS*.

By P. A. MAPLESTONE, D.S.O., M.B., Ch.B., D.T.M.

(From the Hookworm Research Laboratory, School of Tropical Medicine and Hygiene, Calcutta.)

The worms about to be described were obtained in large numbers from the stomach and intestines of a small gibbon monkey (*Hylobates hoolock*), that died in the Calcutta Zoo.

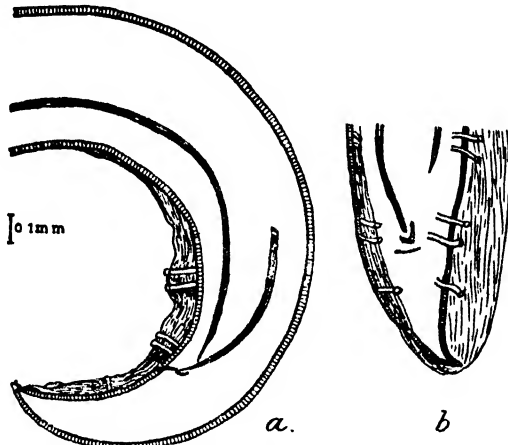
The worms are pearly white and semitransparent and the oesophagus, which is deep brown in colour, can be easily seen with the naked eye. They are slightly more attenuated anteriorly than posteriorly. There are distinct transverse striations on the cuticle, and lateral flanges are absent. The cephalic cuticle presents an asymmetrical expansion, and the cervical papillae are correspondingly asymetrically placed, the more anterior one being about opposite the junction of the pharynx with the oesophagus, and the more posterior one behind the nerve ring.



TEXT-FIG. 1.—*Streptopharagus magnus*, n. sp. a. Anterior end, end-on view. b. Anterior end, dorso-ventral view. c. Anterior end, lateral view.

The mouth is roughly hexagonal in shape (fig. 1a), with its greatest diameter dorso-ventral, and it is bordered by two lateral lips; each lip bears three papillae, sub-dorsal, lateral and sub-ventral. On each side of the mouth there are three teeth with single cusps directed inwards;

they arise from just within the anterior end of the chitinous pharynx, and they are separated dorsally and ventrally by a notch in the chitinous mouth opening. The worms differ in this respect from *S. armatus*, which has small teeth in these situations. The pharynx is thick-walled, and it has fine transverse striations throughout its length; a little behind the middle of its length it has the characteristic half spiral turn (figs. 1b and 1c). The anterior opening of the pharynx is somewhat wider than the lumen of the pharynx itself; this increase in diameter is brought about by two "terraces," which encircle its opening, and which in optical section have the appearance of two right-angled steps (figs. 1b and 1c). The oesophagus is composed of two distinct portions; an anterior short muscular portion, which is dumb-bell-shaped owing to anterior and posterior expansions with a constriction about its middle; and a longer posterior glandular portion, which gradually enlarges from before backwards. It joins the intestine by a rounded end, which has no trace of bulbar enlargement.

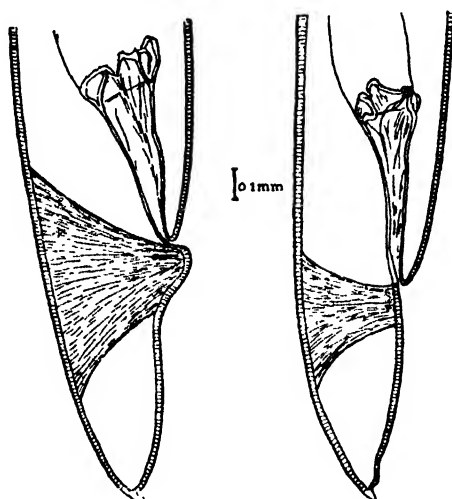


TEXT-FIG. 2.—*Streptopharagus magnus*, n. sp. *a.* Tail of male, lateral view. *b.* Tail of male, semi-lateral view. The caudal ala on the right side is rolled inwards and looks narrower than the ala on the left.

Male.—The males are from 45 mm. to 55 mm. in length, and 0.093 mm. in greatest diameter, and they terminate in two or three spiral twists. The tail ends in a cuticular point, and there are broad symmetrical caudal alae, marked on their ventral surfaces with interrupted longitudinal striations (figs. 2a and 2b). The alae are supported by five pairs of typically drumstick-shaped pedunculated papillae. One pair of papillae is situated about half-way between the tip of the tail and the cloaca, two pairs are just in front of the cloaca, and two more pairs are further forward. No small papillae could be made out near the tip of the tail. There are two thin spicules of unequal length, which end in a sharp point, and the gubernaculum is asymmetrical, having the longer arm on the side corresponding with the longer spicule (fig. 2b).

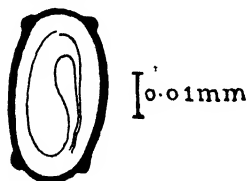
Female.—The females are from 70 mm. to 95 mm. in length with a maximum thickness of 1.35 mm. The tail is straight and it ends in a short cuticular point (fig. 3). The cuticle extends inwards from the

anus forming a funnel-shaped rectum about 0.3 mm. in length; it is fluted at its junction with the gut, and in optical section it presents a striking appearance, as at first sight the thick diverging walls look like two spicules (fig. 3). Just behind the anus there is a strong fan-shaped transverse muscle whose state of contraction probably accounts for the different appearances of this area seen in different specimens.



TEXT FIG. 3.—Tails of two females of *Streptopharagus magnus* showing different appearance of the post anal portions of the worms.

The vulva is small and inconspicuous, and it opens about 20 mm. from the anterior end of the worm; in some specimens two small papillae could be made out, situated one behind the other a short distance in front of the opening. The vagina is not markedly muscular, and it is 3 mm. to 4 mm. in length; it pursues a posterior course and terminates by dividing into two uterine tubes, which at first both run posteriorly, but one branch eventually turns forwards and ends in an ovary a little behind the middle of the oesophagus, and the other branch continues



TEXT FIG. 4.—Egg of *Streptopharagus magnus*, n. sp.

its posterior course to end in its ovary behind the anus. The two uterine branches are wide simple tubes closely packed with eggs. The eggs have thick, smooth shells, they are oval in shape and have a slight thickening encircling each pole, which gives them a slightly quadrangular appearance in optical section. They are 36-40 μ in length and 20-22 μ in breadth, and they contain embryos (fig. 4).

According to Baylis (1923) there are four species in the Genus *Streptopharagus*, viz., *S. armatus* Blanc, 1912, *S. pigmentatus* (Linstow, 1897), *S. numidicus* Seurat, 1917, and *S. sudanensis* Baylis, 1923.¹

From the table of dimensions of these different species given by Baylis (1923), it is obvious that the worm under discussion is quite distinct

¹ Ortlepp (1925) in a review of the genus has created two additional species, *S. intermedius* and *S. baylisi*; these are however quite distinct from *S. magnus*.

from all but *S. pigmentatus*, and if due allowance is made for the larger size of the females in the writer's material the difference between these two worms is so slight as to be practically negligible. There are other points of difference than that of size, however, which it is considered justify the erection of a new species under the name *Streptopharagus magnus*.

In Linstow (1897) the figure of the anterior end of the worm shows it to be thickly stippled with pigment, whereas the present species is quite free from such dots, being of exceptional whiteness and transparency. The same drawing of Linstow shows the cephalic expansion to be symmetrical, whereas the same structure in *S. magnus* is distinctly asymmetrical. Linstow states that the male "bursa" of *S. pigmentatus* is asymmetrical whereas in *S. magnus* the alae are of the same size. In the female, Linstow says the vagina is very muscular, and he shows no cuticular point at the end of the tail in *S. pigmentatus*, while in *S. magnus* the vagina is a rather delicate tube, and there is a short point composed only of cuticle at the end of the tail, in both sexes. Other less striking differences are the considerable coarser transverse striations in *S. magnus*, and the relatively greater length of the oesophagus in this species.

The measurements of *S. magnus* are given below, and so as to make them readily comparable with the other species of the genus, the same headings as those given by Baylis (1923) are made use of.

| | Male. | Female. |
|---|-------------------|-------------------------|
| Length (maximum) | 55 | 95 |
| Thickness (maximum) | 0.93 | 1.35 |
| Tail, length | 0.49 | 0.90 |
| Distance from ant. end to end of oesophagus . . | 8.10 | 11.12 |
| " " " " " ant. div. of oesophagus . | 0.90 | 1.35 |
| " " " " " nerve ring | 0.65 | 0.90 |
| " " " " " excretory pore | .. | 1.0 |
| " " " " " end of pharynx | 0.33 | 0.49 |
| Cuticular striations, distance apart | 0.018 | 0.20 |
| Spicules, length | L. 5.0 R. 0.76 | .. |
| Accessory piece, length | 0.064 | .. |
| Vulva, distance from anterior end | .. | 20.0 |
| Vulva divides total length in proportion of (roughly) . | .. | 4 : 15 |
| Ova, measurements | .. | { 36—40μ × 20—22μ |

(All measurements except those of the ova are in millimetres.)

Type-specimens of *Streptopharagus magnus*, n. sp. have been placed in the Indian Museum, Calcutta.

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THE STOMACH OF *PALUDOMUS TANSCHAURICA* (GMELIN).

By R. V. SESHAIYA, Mahant's High School, Tirupati.

This paper deals with the structure of the stomach and the style sac in *Paludomus tanschaurica* (Gmelin)¹, and I give below the results of my investigations. I have also added a few comparative notes on the forms in which the structure has been investigated by previous authors. My best thanks are due to Dr. H. S. Rao of the Zoological Survey of India, Calcutta, for the correct identification of the species, and to Lt.-Col. R. B. Seymour Sewell, Dr. Baini Prashad and Dr. F. H. Gravely for suggestions and criticisms. Lt.-Col. Sewell was also kind enough to draw my attention to some of the papers cited in the list of references.

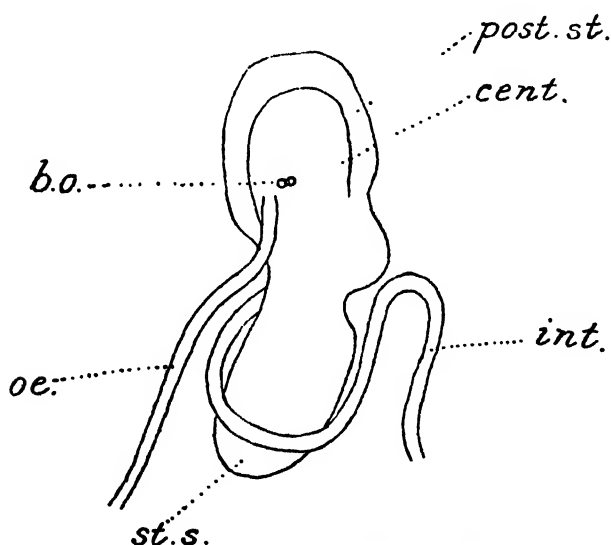
In recent years several papers have appeared on the crystalline style and the associated structures of Gastropods, and lists of the genera, which have a crystalline style, have been published by Robson (11) and Mackintosh (5), but neither of the authors mention *Paludomus* Swainson in their lists. In the family Melaniidae (=Tiaridae), to which *Paludomus* belongs, a crystalline style has been recorded in the genera *Melania*, *Bythoceras* and *Nassopsis*. Mackintosh in the paper cited published a figure of the stomach of *Melania*, and stated that the condition is typical and that the crystalline style is lodged in the anterior chamber of the stomach, but gave no details of the structure. Moore (6) had earlier made passing reference to the stomachs of *Bythoceras* and *Nassopsis*, but he also did not deal with the anatomy in detail.

In describing the structure of the stomach of *Paludomus* it will be useful to indicate the general course of the alimentary canal. The oesophagus is a narrow tube, about 15 mm. in length; it runs in a fairly straight line, and, passing ventral to the stomach, opens into it on the ventral surface slightly to the left of the middle line. The intestine, after leaving the stomach, forms a loop over the anterior part of the stomach, and then passes towards the posterior portion where it turns round to be continued into the mantle cavity. It thus forms a double (S-shaped) curve, and the anterior portion of the stomach lies under the first part of the curve. The liver or the hepatopancreas does not extend to the dorsal surface of the stomach, but lies below the stomach and along its right, left and posterior margins.

Externally the stomach is marked off by a slight constriction into an anterior and a posterior portion. It is about 10 mm. long, and its posterior portion, which is slightly the longer of the two, is about 5.5 mm. long. The oesophageal opening into the stomach has already been mentioned; the openings of the ducts of the hepatopancreas are two in number and are on the ventral surface in close apposition near the oesophageal opening. The intestine starts from the junction of the anterior and posterior chambers of the stomach, more towards the dorsal surface.

¹ For the synonymy of the species see Preston, H. B.—*Faun. Brit. Ind. Freshw. Moll.*, p. 47 (1915).

The anterior chamber of the stomach is thimble-shaped, and its walls, owing to a thick investment of connective tissue on the exterior, are fairly thick except in the region of the termination of the style sac. This chamber lodges the crystalline style and may, therefore, be termed the style sac. The style sac is thus only a diverticulum of the stomach proper, and the termination of the style lying inside it can be distinguished externally as a translucent area on the stomach wall. The cavity of the anterior chamber, which is roughly of the shape of the contained style, is club-shaped. The inner surface is brownish, shining, and appears smooth to the naked eye. The style sac opens by a circular opening into the stomach proper, and this opening bears on the pyloric side two projections lying almost opposite one another. Between the projections is a transverse slit, which connects the pyloric portion of the stomach with the opening of the style sac, but there is no well developed pylorus lying alongside the style sac in *Paludomus*. The connection between the pylorus and the style sac is thus confined to the region of the opening of the style sac and does not extend along the whole length of the latter, as has been described by Robson in *Hypsobia* (10) and *Paludetrina* (11). On the pyloric side running along the whole length of the style sac is a ciliated groove which is in communication with the cavity of the sac throughout its entire length. It opens posteriorly along with the opening of the style sac and forms the slit-like connection between the opening of the sac and the pyloric region of the posterior chamber of the stomach. Comparing this condition with the forms in which the pylorus and the style sac are in communication for a considerable distance,



TEXT-FIG. 1.—The stomach of *Paludomus tanschaurica* dissected out and viewed from the ventral surface. *b. o.*, openings of the hepatopancreatic ducts; *cent.*, central portion of the dorsal wall; *int.*, intestine; *oe.*, oesophagus; *post. st.*; posterior chamber of the stomach; *st. s.*, style sac.

the groove is to be considered as a result of the separation of the style sac from the intestine. Anteriorly the groove turns to the anterior

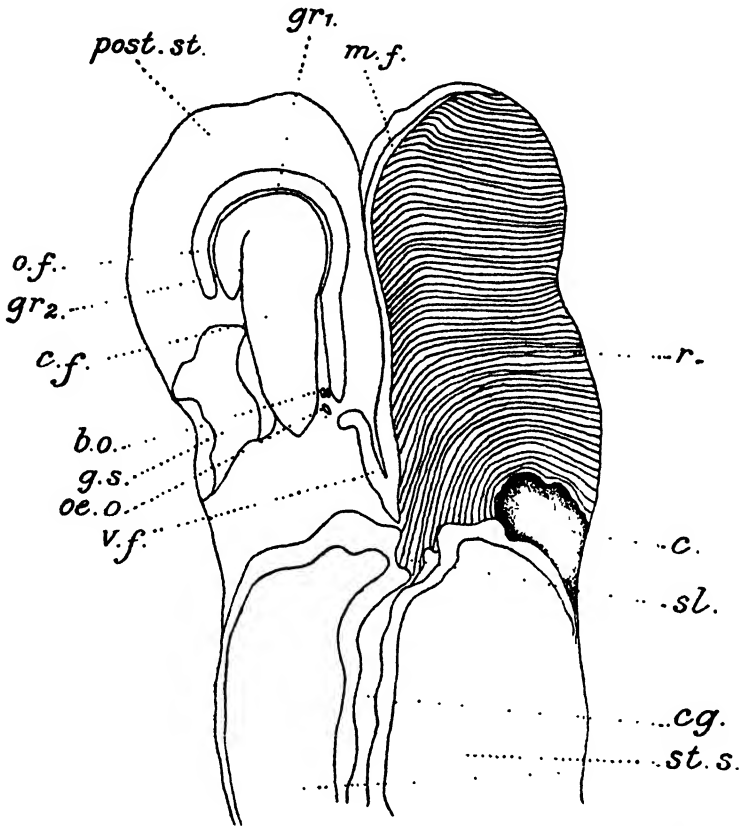
wall of the style sac where it is in communication with a translucent, circular area in which the anterior end of the style appears to be held.

The style is flexible and club-shaped, about 4-5 mm. long. It is thicker at its anterior end, and tapers towards the posterior which is directed into the gastric portion of the stomach. It is usually of a distinct brownish colour, but is often much paler. The structure of the style is the same as in other Gastropods.

The posterior chamber of the stomach forms the gastric portion proper, and is, as noted above, slightly longer than the anterior chamber. It bears on its right margin a lateral protuberance, while its dorsal wall on the inner surface has 40-50 ridges, which for the most part run transversely. The central part of the ventral wall has a number of conspicuous folds which may be designated as the gastric folds. The folds are three in number, an inner, an outer, and a less prominent lateral fold. The central or inner fold is broader and rounded in its posterior portion and tapering in the anterior portion. The outer fold is much narrower than the inner fold, and runs as a ridge round the inner fold along the left, posteriorly and partly on the right side. Between these folds runs a gutter-like structure, while a shallow groove lies along the right margin of the inner fold. As a result of these folds the cavity of the posterior portion of this chamber becomes much less deep than that of the anterior part. The lateral fold runs along the left margin of the ventral wall of the posterior chamber, and near its anterior end is bent in a V-shaped manner. The V-shaped bend of the marginal fold is directed inwards and comes to lie a little below the openings of the oesophagus and the ducts of the hepatopancreas, which on opening the stomach are seen to lie near the commencement of the gutter between the inner and the outer folds. The gutter thus forms a continuation of the oesophageal cavity, but its epithelial lining is of a different type from that of the oesophagus. The function of these folds appears to help in the thorough mixing up of the contents of the gastric chamber. In transverse sections of the posterior chamber the food contents are found lying between the inner and the outer folds, and in the living animal these appear to be worked into the gutter by the cilia of the epithelium lining the folds. The openings of the oesophagus and the ducts of the hepatopancreas are, as has been noted already, in close proximity, and the food material and the secretions from the hepatopancreas are apparently mixed up and directed into the gutter by the cilia mentioned above. Similarly the marginal fold appears to prevent the food from passing directly into the anterior portion of the stomach. From the gutter the food is later passed into the anterior end of the stomach where it is subjected to the action of the free end of the crystalline style.

In the lower portion of the central gastric fold the epithelium of the stomach develops a cuticular investment which forms the "gastric shield." This shield, on dissection, is found to lie on the ventral wall of the stomach in contact with the lower portion of the inner gastric fold, and appears as a glassy, transparent structure of the consistency of cartilage. It is about 1.5 mm. long and 0.5 mm. broad, and extends to nearly the opening of the style sac. Viewed from above it appears concave and fits in between the right margin of the stomach and the lower

portion of the inner gastric fold ; it does not extend to the dorsal wall. Lying between the inner gastric fold and the margin of the ventral wall of the stomach it forms a trough-like cavity into which the free end of the style can be worked. In favourable sections I have observed the head of the style surrounded by gastric contents lying against the gastric shield.



TEXT-FIG. 2.—A figure of the dissected stomach of *Paludomus tanschaurica*. The style sac is not shown. *b.o.*, openings of the hepatopancreatic ducts ; *c.*, cuticular region of the dorsal wall ; *c.f.*, central fold ; *c. g.*, ciliated groove ; *gr. 1.*, gutter between the folds ; *gr. 2.*, shallow groove in the central fold ; *g.s.*, gastric shield ; *m.f.*, marginal fold ; *oe. o.*, oesophageal opening ; *o.f.*, outer fold ; *post. st.* posterior chamber of the stomach ; *r.*, ridges on the inner surface of the dorsal wall ; *sl.*, slit of communication between the openings of the style sac and the pylorus ; *v. f.*, V-shaped bend of the marginal fold.

Histology.—The wall of the stomach is lined by ciliated epithelium. The ciliated epithelial lining in the region of the folds is placed over specially raised areas, and is well developed with large cilia projecting into the cavity of the stomach. Towards the anterior end the central fold becomes narrower, and acquires a thick, cuticular lining which is continued along the right margin and forms the gastric shield. The cells underlying the cuticular investment are devoid of cilia. The region opposite that of the gastric shield is also covered with a cuticular lining, but this is not so thick as that of the gastric shield ; it extends

over the major portion of the lower part of the posterior chamber. Except in the cuticular region the dorsal inner surface of the stomach shows ridges, running transversely for the most part. In longitudinal sections these ridges are seen as folds, each of which is roughly conical with a rounded apex. The epithelial cells covering the folds are ciliated, but the cilia are not so numerous as those on the gastric folds described already. Similar folds are present in the regions of the openings of the oesophagus and the ducts of the hepatopancreas.

The entire stomach is lined by ciliated epithelial cells except in the region of the gastric shield and the cuticular investment described above. The cells of the gastric folds are narrow, columnar cells with well developed cilia, and are densely crowded. The cilia are less than a quarter of the length of the cells, and do not form an even coating as in the case of the style sac epithelium.

The region of the openings of the oesophageal and hepatopancreatic ducts is, as noted already, characterised by the presence of conical folds. The cells forming these folds are large and possess prominent, oval nuclei. The cells are broader than those of the general epithelial covering and have fewer cilia. The function of these folds appears to be glandular as some of the cells are filled with a clear secretion.

The cells underlying the gastric shield are devoid of cilia, and apparently secrete the gastric shield. The shield, when viewed in sections, shows faint striations corresponding to the outlines of the cells underlying it. The cells on the right side of the gastric shield are narrow, columnar and devoid of cilia, and have a cuticular covering. The cells further have a characteristic black pigment similar to the one noticed by Robson (11) in the case of *Paludestrina*.

Ciliated cells are also present on the projections bounding the region of communication between the pylorus and the style sac. The epithelium of the style sac consists of columnar cells of strikingly uniform size and shape. The cells are longer than broad, and each cell has a single nucleus. Mackintosh (5) mentions two in the case of *Crepidula*. The cytoplasm in the upper portion of the cells is densely granulated. The cilia on the surface form a uniform coating along the entire inner surface of the style sac, and all the cilia are of the same length, being about one-third the length of the cells themselves.

General.—The chief feature of the stomach of *Paludomus* is the nature of the connection between the pyloric region of the stomach and the style sac. A slit-like connection between the pylorus and the style sac has been described by Robson in *Hypsobia* (10) and *Paludestrina* (11). In *Paludestrina* there is a well developed pylorus from the anterior extremity of which the intestine is given off, while the opening of the style sac lies parallel to it and in the same plane. Further the style sac and the pylorus are in communication by a "narrow slit extending down the whole of their length." In *Paludomus* on the other hand a well developed pylorus is absent, and the slit-like communication is confined only to the region of the opening of the style sac, which in this case is reduced to a transverse slit. The separation between the pyloric and caecal elements of the stomach in *Paludomus* is much greater than in *Paludestrina*.

In genera like *Turritella* and *Pterocera* the style sac is separated from the intestine, while in *Fissurella* and *Cyclostoma* a style is found in the intestine itself. Forms like *Hypsobia* and *Paludestrina* are intermediate between these two types as there is a separate communication between the style sac and the pylorus. The condition in *Paludomus* appears to be more specialised than in *Paludestrina* as there is almost a complete separation between the style sac and the intestine. The course of evolution appears to be one of progressive separation between the style sac and the pylorus from one of primitive union, and *Paludomus* appears to supply the last link in the series. The transverse slit-like communication between the style sac and the pylorus in *Paludomus* is merely the termination of the ciliated groove, and this may be taken as an additional argument for the hypothesis that the ciliated groove is the result of the separation between the intestine and the style sac.

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AN ACCOUNT OF THE OLIGOCHAETA OF TRAVANCORE.

By K. S. PADMANABHA AIYER, M.A.

(Plates I-V).

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INTRODUCTION.

The present paper¹ is the result of my investigation of the material collected by me from several parts of Travancore mainly during 1926-27. The most favourable time of the year for making collections of earth-worms in this part of the country is immediately after the South-West and the North-East monsoons, i.e., during July-August and November-December respectively. Consequently it was not possible to visit more localities than the few that I did. Nevertheless, judging from the new forms encountered, the results are encouraging and indicate forcibly the fact that, though a large number of forms have already been recorded

¹ Thesis accepted for the degree of Doctor of Science of the University of Madras.

from this part of India, our knowledge of the Oligochaete fauna of this interesting region is still far from complete.

The first account of Oligochaetes from Travancore is by Miss S. M. Fedarb in 1897 (7). Practically very little was known till the publication of the valuable papers by Dr. Michaelsen in 1910 and 1913 (9, 10). Dr. Stephenson has since described several forms from this region from material sent to him by the authorities of the Indian Museum at Calcutta, and by the Zoological Survey of India, and a complete account of forms up to 1923 was published in that author's volume on Oligochaeta in the "Fauna of British India" (20).

Among the points of interest in the aquatic oligochaetes dealt with in the present paper may be mentioned the discovery of a new genus of Naididae and the discovery of diffuse production of sexual cells in *Aeolosoma travancorense* Aiyer.

Our present knowledge of the terrestrial oligochaetes of Travancore extends to 49 species as follows:—

(Species marked by asterisks have been recorded by the writer.)

Fam. Moniligastridae.

- Moniligaster deshayesi* E. Perr.
 " *perrieri* Mich.
Drawida barwelli Bedd.
 * " " var. *impertusa* Steph.
 " *ghatensis* Mich.
 " *pellucida* var. *pallida* Mich.
 * " " f. *typica* Bourne.
 " *travancorensis* Mich.
 " *schunkari* Mich.
 * " *circumpapillatus*, sp. nov.

Fam. Megascolecidae.

- Plutellus timidus* Cogn.
 * " *variabilis*, sp. nov.
 * *Pontodrilus bermudensis* Bedd.
 * *Woodwardiella kayankulamensis*, sp. nov.
 * *Megascolides chengannures*, sp. nov.
Notoscolex ponmudianus Mich.
 " *tenmalai* Mich.
 * " " var. *ghatensis*, nov.
 * " *peermadensis*, sp. nov.
 * " *travancorensis*, sp. nov.
 * " *minimus*, sp. nov.
Megascolex eunephros Cogn.
 " *insignis* Mich.
 " *konkanensis* Fedarb.
 " *pumilio* Steph.

Megascolex ratus Cogn.

- " *travancorensis* Mich.
 * " " var. *proboscidea*, nov.
 " *trivandranus* Steph.
 * " *auriculata*, sp. nov.
 * " *avicula*, sp. nov.
 * " *peermadensis*, sp. nov.
 * " *kumiliensis*, sp. nov.
 * " *polytheca* var. *uniquus*, nov.
Pheretima bicincta (E. Perr.)
 " *travancorensis* (Fedarb).
 " *trivandranus* Steph.
 * " *taprobane* Bedd.
Octochaetus aitkeni (Fedarb).
 " *pittnyi* Mich.
Dichogaster affinis Mich.
 " *bolani* Mich.
 " *malayana* Horst.
 " *travancorensis* Fedarb.
Ocnodrilus occidentalis Eisen.
 * *Malabarica biprostata*, sp. nov.
Eudrilus eugeniae Kinb.
Gordiodrilus travancorensis Mich.
Fam. Lumbricidae
Glyphidrilus annandalei Mich.
Helodrilus foetidus Steph.

As a result of the present investigation the genera *Woodwardiella*, *Megascolides*, and the recently discovered Ocnodrilid genus *Malabarica* are now known to be represented in this region each by a new species. Three new species and a new variety of *Notoscolex* were found, while of *Megascolex*, which is already well represented, 4 new species and 2 new varieties are described. *Plutellus* and *Drawida* each gain a new species. It is also interesting to note that *Pheretima taprobane*, widely known from other parts of the world including Ceylon, is now recorded from India for the first time.

Among the structural peculiarities noted in the specimens of the present collection special mention may be made of the retractile proboscis

in a variety of *Megascolex travancorensis* and the glands in connection with the vas deferens in *Moniligaster deshayesi*.

I wish to take this opportunity to express my deep gratitude to Dr. J. Stephenson of the University of Edinburgh for the very kind and most helpful suggestions he has so generously given me from time to time during the progress of this work. I have also to thank Dr. W. Michaelsen of Hamburg and Dr. E. Piguet of Geneva for their kindness in sending me some of their valuable monographs.

Family AEOLOSOMATIDAE.

Genus *Acolosoma* Ehrbg.

Acolosoma travancorensis Aiyer.

(Plate I, fig. 1.)

This minute worm described by me in 1926 (2) from specimens obtained from a tank in Trivandrum has since been found to occur in tanks at Chirayinkil and Nagercoil. The specimens from the two latter localities were found living in minute tubes curved like the arc of a circle. The tube is made of a thin layer of mucus to which the worm's excreta and debris are attached.

In most of the present specimens, there are, scattered on the body, especially towards the hinder part, a small number of colourless oil globules.

Sexual reproduction.—A number of sexual specimens were obtained from the sample of mud from Nagercoil in May, 1927. These were subjected to careful examination under the microscope. No specimen was sectioned since even the fully mature worms were transparent enough to allow the internal organs to be studied. Before dealing with the reproduction in this species I shall quote below from Beddard's monograph what is already known about the genital organs of this genus :—

“D'Udekum, Maggi and Stolc appear to have investigated the same species, viz., *A. hemprichi* and *A. quaternarium*. The testis is median and unpaired and lies in the fifth segment; the ovary occupies a corresponding position in the sixth segment. There are no sperm ducts; the nephridia, particularly those of the sixth segment, which is slightly different in structure from the rest, serving as conduits of the sperm. The ova, which are few and large and apparently undergo amoeboid movements, escape by a large pore on the ventral surface of the sixth segment. The spermathecae are small oval sacs, one to three pairs occupying segments III-V. At the epoch of sexual maturity a clitellum is formed, which is figured by Stolc as limited to segments V-VII; it is only developed on the ventral side of the body.”

Clitellum.—The first point that is worthy of note in connection with sexual reproduction in the present species is the entire absence of a clitellum,

Male cells.—In mature individuals large numbers of sperm morulae and clusters of ripe spermatozoa are present throughout the body cavity and float about freely in it. In specimens less advanced in sexual maturity sperm morulae occur mostly in the intestinal region, though a few are seen floating about in the oesophageal region. In maturing individuals undergoing fission at the same time (several of the sexual specimens examined were also dividing asexually) morulae are seen mostly in the posterior individual.

Careful examination of a number of specimens convinced me of the absence of a testis. The presence of morulae in large numbers in the intestinal region of maturing individuals led me to look for male cells in the coelomic epithelium of this region. Several days were spent in the search for specimens showing the production of male cells. Four such individuals were at last found from which the following facts were made out. Three of the specimens were single individuals and one was just preparing to divide by fission.

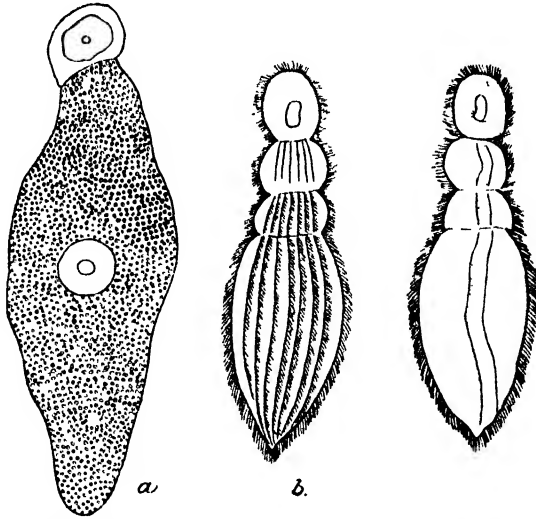
The contractile dorsal blood vessel, which in the oesophageal region is only as wide as the oesophagus, is in the intestinal region wider than the gut. Under pressure of the cover slip and especially during the contraction of the body the vessel looks very much wider than the intestine. The wall of this vessel is composed of long, extremely thin, fusiform cells which appear as little thickenings here and there in the otherwise uniformly thin wall. In the four specimens referred to above the wall of the dorsal blood vessel had produced in the intestinal region behind the stomach a number of conspicuous oval or rounded finely granulated uninucleated cells (Plate I, fig. 1). Such cells were also present but much less abundantly in the wall of the dorsal vessel in the oesophageal region. These are the spermatogonia or male cells. While a few male cells were seen floating in the body cavity, a large number of them, together with the early morula stage, were attached to the wall of the blood-vessel. It appears, therefore, that the spermatogonia become multinucleate prior to detachment from the wall of the vessel and that the few male cells found in the body cavity are the ones torn forcibly from it by the pressure of the cover slip as water is drained off from beneath it. A few free morulae were present in the body cavity in these specimens but very few or no fully-developed spermatozoa. The production of male cells was not observed in any other part of the body.

A sperm sac is absent. This is in correlation with the absence of septa and the diffuse production of male cells.

There are no special ducts for the passage of the sperms to the outside. The spermatozoa probably escape by means of the nephridia but I did not notice any actually passing through them.

Ovary and ova.—I did not notice an ovary in any of the numerous specimens examined. In fully mature individuals there is a single large ovum (text-fig. 1a) filled with spherical yolk granules on the ventral side of the stomach in segment V. The ovum extends from the setal level of segment V, to the setal zone of segment VI and in one specimen measured 180 μ long and 54 μ wide. There is a clear circular yolk-free space in the centre which is occupied by the large rounded nucleus with a distinct nucleolus. Attached to the anterior end of the large ovum is a cell much

smaller in size and free from yolk granules. In half mature individuals two translucent (groundglass-like) cells are seen one behind the other on the ventral side of the stomach in segment V. Each of these is about



TEXT-FIG. 1.—*Aelosoma travancorensis*: a., ovum with accessory cell; b., Ciliate parasite \times ca. 350; c., the same showing meganucleus, \times ca. 350.

the same size as the anterior cell referred to above. These two cells can be nothing else than oöcytes. In all probability only two oöcytes are produced, the hinder one developing into the ovum and the anterior one remaining as an "accessory," "nutritive" or "nurse" cell.

Oviducts are not present and the escape of the large ovum to the outside must be by the rupture of the body wall. No pores were noticed on the ventral side of segment V or VI.

Spermathecae are not present.

The points observed may be summarised as follows :—

1. A clitellum is not developed.
2. There is no testis. Male cells are produced from the wall of the dorsal blood vessel. There is no sperm sac. The morulae develop in the body cavity. There are no special genital ducts for the escape of the spermatozoa.
3. Ova are produced from the ventral body wall in segment V. There are no oviducts.
4. Spermathecae are absent.

This species presents important differences from the two species *A. hemprichi* and *A. quaternarium* whose reproductive organs have so far been investigated. The absence of a clitellum and localised male gonads and the absence of spermathecae are undoubtedly important differences in the species of a genus and perhaps of sufficient importance as to justify its splitting into subgenera, but nothing definite can be said on this point till the sexual organs of the other Indian species of the genus have been worked out. *A. kashyapi* and *A. bengalense* are both

common in Travancore and when sexual specimens of these become available they will be studied and described.

Stephenson (19) has previously described a similar kind of diffuse production of male cells in *Chaetogaster orientalis*. At the end of his paper Stephenson remarks, "that this condition, which is not unlike that of the Polychaeta, represents a regression, and not the persistence of a primitive state, may be taken as certain." This may be true of the genus *Chaetogaster* whose ectoparasitic and commensal habits have brought on numerous modifications in its body structure. On the other hand in *Aeolosoma* the condition can be regarded only as the persistence of a primitive state.

Parasites.—An astomatous ciliate parasite (text-fig. 1b, c) allied to *Anoplophrya* was present in the stomach of several individuals, as many as seven occurring in the stomach of a single specimen. The parasite is ovoid in shape and 200-225 μ in length. The cilia are arranged in longitudinal rows. The long meganucleus extends from one end of the body to the other. Reproduction is by multiple fission, the posterior part of the body dividing transversely into 3, 4 or sometimes 5 oval individuals, all of which remain attached to the parent for some time in a chain. Micronuclei and contractile vacuoles are apparently absent.

Family NAIDIDAE.

Genus *Nais* Müll. em. Vejd.

Nais pectinata Steph.

Kottayam, 20th April 1927. Numerous specimens.

The species was first described in 1910 by Stephenson (16) from specimens obtained from *Spongilla carteri* taken at Bheemanagar, Travancore. The present specimens were attached to *Hydrilla* and other aquatic plants.

External characters.—The worm is of a pale whitish colour and is 4.6 mm. in length during life. The number of segments varies within wide limits. In the longest specimen examined 65 segments were counted, while the smallest specimen had 24 segments.

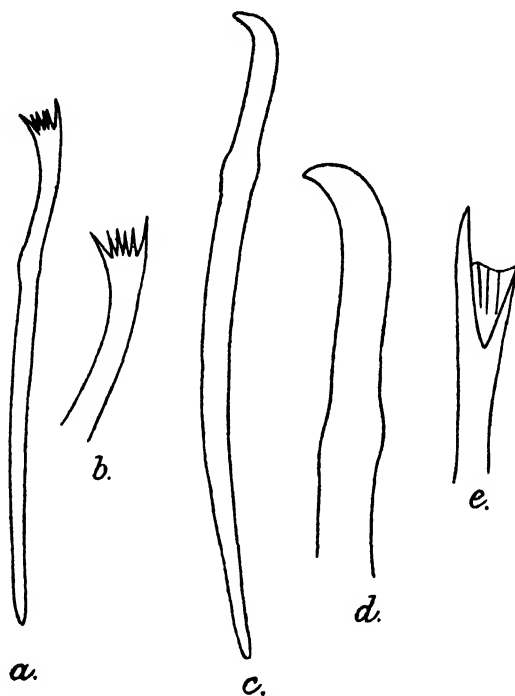
The number of ventral setae in a bundle varies from 3 to 7, 5 being regularly the number in segments II to V; Stephenson gives 3 as the number in his examples.

The dorsal bundles usually consist of one hair and one needle, but bundles composed of one hair and two needles and rarely two hairs and two needles also occur. The distal fourth of the needle seta (text-fig. 2 a) is slightly sickle-shaped and an indistinct nodule is present at the end of the straight portion of the shaft. Four intermediate prongs are present between the two outer prongs (text-fig. 2 b).

The lengths of the setae in a few segments are given in the following table. (The measurements noted are in microns.)

| No. of segments | II | III | IV | V | VI | VIII | XIII | XXIII |
|--------------------|----|-----|----|----|-----|------|------|-------|
| Needles . . . | .. | .. | .. | .. | 57 | 54 | 62 | 58 |
| Hair setae . . | .. | .. | .. | .. | 180 | 180 | 220 | 200 |
| Ventral crotochets | 65 | 62 | 62 | 60 | 58 | 58 | 52 | 58 |

Internal anatomy.—There is no stomach dilatation. Coelomic corpuscles are numerous and are 10μ in diameter. The first nephridium is in segment VII.



TEXT-FIG. 2.—*Nais pectinata* : a., dorsal needle, \times ca. 1790 ; b., distal end of dorsal needle, more magnified ; c., penial seta, \times ca. 1860 ; d., distal end of penial seta, more magnified ; e., tip of dorsal needle of *Nais pectinata* var. *inequalis*, \times ca. 3000.

The dorsal vessel is attached to the alimentary canal along its left side as far as segment VI in which it crosses over to the dorsal side of the oesophagus. It then runs straight forwards and gives off four pairs of transverse commissures in segments V-II. The commissures in segment II are the stoutest and are given off immediately behind the brain. In front of the brain the dorsal vessel divides into two branches, a right and a left, which run backwards along the sides of the pharynx and unite below it in segment II, at the level of the ventral setae, to form the ventral vessel. A short vessel on each side connects each of the first pair of transverse commissures in segment II with the corresponding branch of the dorsal vessel in front.

The brain is deeply indented both in front and behind.

Sexual reproduction. Sexual individuals were obtained in fairly large numbers. The clitellum extends over $\frac{1}{2}$ V- $\frac{1}{2}$ VII-VII- $\frac{1}{2}$ VIII (=2-3 segments). The spermathecae are long cylindrical sacs in segment V, and the single sperm sac extends backwards to segment XII.

As the worm becomes sexually mature the dorsal setae of segments VI and VII are lost. The penial setae are the modified ventral setae of segment VI, 4-5 per bundle. Each penial seta (text-fig. 2 c, d) is 68μ long (never longer) with a blunt, slightly curved, tip. The tip is not

usually bifid, but sometimes a very minute indistinct prong, representing the outer prong, is present.

In fully mature individuals the alimentary canal degenerates into a narrow cord in front of segment XIV.

***Nais pectinata* var. *inequalis* Steph.**

Specimens of this worm were fairly abundant in a tank in Trivandrum in July, 1926.

The only point on which I wish to add a note is the dorsal needle. The needle seta is 72μ long and has a very faint nodulus, distal to the middle of the shaft, beyond which is a slight sickle-shaped curve. The prong on the convex side of the curve is only half as long, and less than half as thick, as the inner prong. These two prongs could only be made out with the high power objective. On using the oil immersion lens it was seen that a webbing (text-fig. 2 e) connects the two outer prongs and is itself supported by two or three intermediate teeth which are of the same length as the prong on the convex side of the curve. The webbing is easily overlooked, as it is not visible when the outer prongs are focussed.

***Nais communis* Piguet var. *punjabensis* Steph.**

A tank at Nagercoil, 1st June 1927. Numerous specimens.

Genus *Naidium* O. Schm.

***Naidium menoni*,¹ sp. nov.**

Specimens of this worm were obtained from a tank at Chirayin'il in October, 1926 and later from a tank in Trivandrum in June, 1927 along with *Naidium breviseta*.

The worm is smaller in size than *N. breviseta*; single individuals measuring 5 mm. in length when living and chains of two individuals about 7 mm. The movement of the worm resembles that of *N. breviseta*. The number of segments in single individuals or chains may vary between 32 and 50.

The prostomium is slightly longer than broad and has a more or less rounded anterior margin. Sensory hairs are absent.

The ventral setae begin in segment II and consist of ordinary bifid crotchets. The setae of segment II and sometimes of II and III are shorter than those of succeeding segments. In the setae of the anterior segments (text-fig. 3 a) the outer prong is slightly longer than the inner but the prongs are equal from segment X backwards (text-fig. 3 b). As is clear from the table of measurements below the nodulus is at the middle of the shaft in the setae of segment II, slightly distal to

¹ Named after my old teacher, Professor K. R. Menon of the Presidency College, Madras.

the middle of the shaft in segment III, and distinctly distal from segment IV backwards.

| No. of segments. | Distal : proximal. |
|------------------|--------------------|
| II | 20 : 20 |
| III | 20 : 25 |
| IV | 20 : 30 |
| VII | 20 : 30 |
| XXVIII | 18 : 30 |

The number per bundle is usually 5 in the anterior segments and 4-2 in the posterior segments. A single specimen was found with the following unusual numbers :—

Seven per bundle in segment II, 6 in III, 5 in IV-V, 6 in VI-VIII, 5 in IX-XIV and 4-3 in the posterior segments.

The dorsal setae, which begin in segment II, consist of one needle and one hair seta per bundle, rarely two needles and two hairs or one needle and two hairs. The distal half of the needle seta (text-fig. 3 c) has a bayonet-shaped or sigmoid curve and the tip is single pointed. There is no nodulus. The hair is almost straight and without any ornamentation. The needles and hairs of segments II and III are, like the ventral setae of these segments, shorter than those of the succeeding segments. The lengths (in microns) of the setae in three individuals are shown below :—

Specimen 1. (Chirayinkil)—

| No. of segments | II | III | IV | V | VI | IX | XXI |
|-------------------------|-----|-----|-------|-----|-----|-----|-----|
| Dorsal needles | 45 | 54 | 64.8 | 72 | 79 | 75 | 72 |
| Hair setae | 126 | 170 | 180.0 | 198 | 198 | 162 | 130 |
| Ventral crotchets . . . | 45 | 50 | 54 | 54 | 54 | 54 | 52 |

Specimen 2. (Chirayinkil)—

| No. of segments | II | III | IV | V | VI | IX | XXI |
|-------------------------|----|-----|-----|-----|-----|-----|-----|
| Dorsal needles | 39 | 52 | 74 | 75 | 72 | 60 | 58 |
| Hair setae | 92 | 130 | 144 | 162 | 162 | 144 | 126 |
| Ventral crotchets . . . | 39 | 45 | 54 | 54 | 52 | 46 | 46 |

Specimen 3. (Trivandrum)—

| No. of segments | II | III | IV | V | VI | IX |
|-------------------------|-----|-----|-----|-----|-----|-----|
| Dorsal needles | 50 | 63 | 75 | 72 | 72 | 75 |
| Hair setae | 126 | 162 | 198 | 180 | 225 | 200 |
| Ventral crotchets . . . | 50 | 54 | 54 | 61 | 61 | 61 |

Internal anatomy.—The pharynx is strongly ciliated and occupies segments II and III. The wall of the pharynx is attached to the body wall by means of muscle strands. The oesophagus extends through

segments IV-VI and dilates into the stomach which occupies segments VII and VIII. The stomachal dilatation is usually not so wide as the intestine behind and is, therefore, easily overlooked. The stomach is richly vascular and is covered with a thick layer of chloragogen cells. The inner lining of the stomach consists of a layer of finely granular gland cells, through which run narrow branching ducts. A short narrow ciliated portion connects the stomach with the wide intestine.

Chloragogen cells begin in segment V. There are three pairs of septal glands consisting of masses of clear glassy cells, in segments III, IV and V.

Coelomic corpuscles are numerous. As in *N. breviseta*, these bodies appear black when seen by transmitted light and whitish when seen by reflected light. An average sized corpuscle measures 15μ in diameter.

The first nephridium is in segment IX.

The dorsal vessel runs in close connection with the alimentary canal, lying on its ventral side a little to the left of the middle line. It passes round the gut and comes to lie dorsally in segment VIII. There are three pairs of contractile vascular loops in segments V, VI and VII. The dorsal vessel also gives off transverse commissures in segments IV, III and II, the last pair (that in II) arising immediately behind the brain. The vessel then runs forwards below the brain and emerging on its anterior side divides into two branches (a right and a left), which pass

ventrally and run backwards internal to the lines of the ventral bundles of setae and unite in the middle line, at the level of the ventral setae of segment V, to form the ventral vessel. The vascular loops in segment V join the ventral vessel immediately behind its formation, while each of the transverse commissures in front joins the anterior ventral vessel of the same side. The ventral vessel is non-contractile and is not attached to the alimentary canal.

The brain is widely indented both in front and behind.

Asexual reproduction was noted in several individuals and η was found to vary between 22 and 24. In one specimen η was 28. Seven segments are always intercalated in the budding zone at the anterior end of the posterior individual.

***Naidium breviseta* Bourne.**

The following notes may be added to supplement my account (1) of this species:—

In the specimens obtained from Trivandrum in 1925 the prostomium is longer than broad with a blunt apex and is not drawn out into a



TEXT-FIG. 3.—*Naidium menoni*: a., distal end of ventral seta of anterior region; b., distal end of ventral seta of posterior segment; c., dorsal needle of segment V, \times ca. 1520.

proboscis. The specimens collected later from Trivandrum, Kovilam and Chirayinkil possess a distinct mobile proboscis as in the various species of the genus *Pristina*.

I stated in my previous account that there is no stomach in this species. On examining the recently obtained specimens and comparing these with the new species described in this paper, I find that this species also possesses a stomachal dilatation in segments VII and VIII.

The dorsal vessel which occupies the same position as in *N. menoni* comes to lie dorsally in segment VII. There are three pairs of contractile vascular loops in segments V-VII, and non-contractile (or slightly contractile) transverse commissures in segments IV-II. The ventral vessel is formed at the level of the ventral setae of segment VI. The vascular loops in segment VI join the ventral vessel immediately behind its formation while each of the commissures in front joins the anterior ventral vessel of the corresponding side.

Genus *Pristina* Ehrbg.

Pristina longiseta Ehrb. f. *typica*.

Trivandrum. August, 1924 and August, 1926. Numerous specimens.

The serration of the hair setae (text-fig. 4 a) in the present specimens cannot be said to be slight.

The penial setae (text-fig. 4 b) call for a brief notice. The ventral bundles of segment VI are modified as penial setae, 2 per bundle. Each seta is 72μ in length with the proximal half more strongly curved than the distal. There is a faint nodule a little distal to the middle of the shaft and the distal fourth of the seta is divided into two enormous prongs as in *Naidium breviseta* (vide Stephenson, 25). The prongs, which appear to be connected together by a thin membrane, diverge slightly and meet again at the tip. The resemblance of these setae to the penial setae of *Naidium breviseta* is so striking that it affords one more proof of the affinity between the two genera. Stephenson's figure (20) of the penial seta of this species is different. I, therefore, forwarded my slide to him, and he kindly wrote to me confirming my determination of the species, and added that he must have overlooked the second prong when he examined the seta many years ago. As the seta lies on its side it is not easy to see the inner prong which is situated somewhat below the outer prong.



"EXT-FIG. 4.—*Pristina longiseta* : a., portion of hair seta showing serrations, \times ca. 3040 ; b., penial seta, \times ca. 1520.

***Pristina aquiseta* A. G. Bourne.**

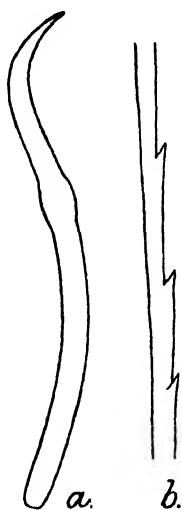
Vellayani lake. August, 1926. Numerous specimens.

Trivandrum. September, 1926. Numerous specimens.

Length of specimens 2-2.5 mm.

In the present specimens the ventral setae of segment V are the "giant setae" and not those of segment IV. Suspecting that this form might be a variety of *P. aquiseta*, I referred the point to Dr. Stephenson who kindly informed me that "Michaelsen in 1913 had worms from S. America which presented the enlarged ventral setae only in segment V, not in IV; so also Hempelmann in Germany in 1923."

The giant seta (text-fig. 5 a) is 63μ long, very much stouter than the ordinary crotchets and has a strong double curve. The nodulus is distal to the middle of the shaft (distal : proximal : : 15 : 20). The proximal prong which is stated by Bourne, Piguet, and others to be rudimentary has in the present specimens completely disappeared, and the seta ends in a simple point, the distal portion beyond the nodulus presenting an appearance not unlike that of the blade of a pruning knife. The number per bundle is usually one. The following exceptional cases have been observed :—



TEXT-FIG. 5.—a., giant seta of *Pristina aquiseta*, \times ca. 1520; b., portion of hair seta of *Pristina proboscidea* showing serrations, \times ca. 3040.

1. In one individual there were three setae in each bundle, one of which was modified as the giant seta, the other two being ordinary crotchets. In the giant seta of one side a minute rudimentary proximal prong was present.
2. In one specimen there were two giant setae in one bundle and one in the other.
3. In two specimens there were two giant setae in each bundle.

The lengths of the setae in the present specimens are shown in the table below for comparison with those of the European specimens described by Piguet (11).

| No. of segments | II | III | IV | V | VI | IX |
|---------------------|----|------|---------|-----|-----|-----|
| Dorsal needles . . | .. | .. | 32.5-35 | .. | .. | .. |
| Hair setae . . . | 91 | 104 | 117 | 130 | 130 | 135 |
| Ventral crotchets . | 45 | 32.5 | 35 | 63 | 39 | 39 |

Piguet's specimens :—

| No. of segments | II | III | IV | V | VI | VIII |
|---------------------|-----|-----|-----|-----|-----|------|
| Dorsal needles . . | 33 | 43 | 49 | 50 | 50 | 54 |
| Hair setae . . . | 121 | 184 | 180 | 197 | 230 | 246 |
| Ventral crotchets . | 62 | 46 | 62 | 56 | 54 | 56 |

The alimentary canal has a covering of chloragogen cells which begin in segment VI. Coelomic corpuscles are present; each consisting of a round cell with granular protoplasm and a few oil-drop-like bodies in it. An average sized corpuscle is 9μ in diameter.

There are two pairs of contractile vascular loops in segments VI and VII, those in VII being stouter. In addition to these there are transverse commissures in segments II-IV.

The brain is indented both in front and behind.

The value of η was 13 in five specimens, 14 in one and 15 in three.

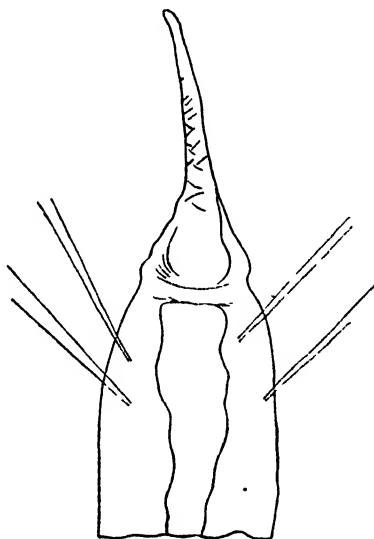
***Pristina proboscidea* var. *paraguayensis* Mich.**

Trivandrum. September, 1926. A few specimens.

Length of single individuals 5 mm.

Number of segments 23-46.

The length of the proboscis (text-fig. 6) varies to some extent. The shortest proboscis was .27 mm. in length and the longest measured .46 mm., three times as long as the prostomium.



TEXT-FIG. 6.—*Pristina proboscidea*, anterior end of body.

The ventral setae are bifid crotchets, 4-9 per bundle in the anterior segments. The setae of segment II are longer and stouter than the rest and have the nodulus exactly at the middle of the shaft. The number per bundle in the anterior segments of two specimens is shown below :—

- | | | | | |
|----------|--------|-------|-----------|-----------------|
| 1. 5/II, | 6/III, | 5/IV, | 6/V-VI, | 8/VII-XIII. |
| 2. 4/II, | 7/III, | 8/IV, | 7/V-VIII, | 8/IX-XI, 9/XII. |

The dorsal setae consist of two hairs and two or three simple pointed needles per bundle.

Lengths of setae in the anterior segments:—

| No. of segments | II | III | IV | V | XII. |
|-------------------------|--------|-------|-----|-----|------|
| Hair setae | 450 | 180 | 360 | 380 | 450 |
| Ventral crotchets . . . | 90-108 | 72-81 | 72 | 72 | 72 |

Hair setae measuring 620μ have been observed about the middle of the body. The serrations of the hair setae (text-fig. 5 b) are visible under the high power of the microscope. They are $6.5-9\mu$ apart in the middle of the seta and vanish proximally but get closer and more distinct distally.

There is a stomach in segment VIII. Chloragogen cells begin about the sixth segment. There are two pairs of contractile vascular loops in VI and VII, those in VII being stouter. Transverse commissural vessels are present in segments II-V. The dorsal blood vessel is sometimes covered with a layer of chloragogen cells as far as segment VII.

Asexual reproduction was noted in a few individuals and η was found to vary between 19 and 24.

Genus *Stephensonia*, gen. nov.

Diagnosis.—Prostomium almost rounded. Ventral bundles of setae begin in II, consisting of bifid crotchets. Dorsal bundles begin in II, consisting of hair setae and simple pointed needles. Four segments only are intercalated in the budding zone at the anterior end of the posterior animal. Clitellum includes $IV\frac{1}{2}$ - $VI\frac{3}{4}$ ($=2\frac{1}{4}$). Testes in IV (?). Ovaries in V (?). Male funnel on anterior face of septum 4/5, vas deferens leading to a pear-shaped atrium in V. Male pores in V. Sperm sac single, formed from septum 4/5 extending into VI. Ovisac single, formed from septum 5/6 extending into VII. Spermathecae in IV. Penial setae internal to the male aperture, 4-5 per bundle.

Stephensonia trivandran, nom. nov.

(Plate I, figs. 2, 3 and 4.)

The species was described by me under the name *Naidium* (?) *trivandranum* in the *Ann. Mag. Nat. Hist.*, Ser. 9, Vol. XVIII, p. 139 (1926).

Sexual reproduction.—Mud containing specimens of this worm was brought to the laboratory in November, 1925, and though it was being examined from time to time, sexual specimens were obtained from this culture only after a lapse of eight months, in June, 1926. It is also worthy of note that only eight specimens were obtained in all, although the mud in the basin had a very large number of asexually dividing individuals. Four of the sexual specimens were examined entire under the microscope and three were sectioned.

The clitellum is conspicuous during life by its thickness and whitish colour. It extends from the level of the setae of segment IV to the level of the setae of segment VI or gets slightly beyond it ($=2\frac{1}{4}$). The clitellum is covered by large transversely elongated cells filled with colourless oil-like droplets. These cells get easily separated from the body wall by the pressure of the cover slip and assume a rounded shape.

The testes were not noticed either in the entire specimens or in the sections. They should presumably have been in segment IV in which the male funnels are seen.

The sperm sac (Plate I, fig. 2) is single and occupies segment V, sometimes extending into segment VI. It is a backward pouch of septum 4/5 and contains morulae and other stages of developing sperms, besides sheaves of ripe spermatozoa.

The male funnels (Plate I, fig. 2) are on the anterior face of septum 4/5 and are distinctly funnel-shaped and ciliated. They are 27μ long and 18μ wide at the mouth. Masses of ripe spermatozoa are seen at the entrance to the funnel. The vas deferens is 9μ wide at its beginning behind septum 4/5. It passes downwards towards the body wall but in none of my serial sections could I trace the entrance of the vas deferens into the atrium; it may possibly be at its upper pole.

The atrium (Plate I, figs. 2 and 4) is an ovoid or pear-shaped sac in segment V, about 54μ long, 36μ wide at its broad ental end, and 27μ at its narrow ectal end. Its lumen is narrow and its wall consists of a single layer of finely granulated columnar cells with basal nucleus. The ectal end of the atrium appears to open directly to the outside without the intermediation of an ejaculatory duct. The male apertures (Plate I, fig. 3) are situated a little external to the ventral bundles of setae on a slight invagination of the body wall. The upper two-thirds of the atrium are covered by a mass of prostatic cells (Plate I, fig. 4). The prostatic cells are pear-shaped with their broad ends turned towards the body cavity and their narrow ends turned towards or attached to the atrium. The protoplasm is finely granulated and the rounded nuclei are situated in the broad portion distally to the centre.



TEXT-FIG. 7.—*Stephensonia trivandran*: a., penial setae, \times ca. 1250; b., distal end of penial seta more magnified.

The penial setae (text-fig. 7a, b) are the modified ventral setae of segment V. There are four or five setae per bundle. Each seta is 81μ

long with the nodulus distinctly distal. The shaft beyond the nodulus has a slight sickle-shaped curve and the tip of the seta is divided into two blunt prongs. In living specimens the setae of a bundle are seen to converge distally so that the bundle presents an appearance not unlike a hollow cone.

The ovaries have disappeared in all the specimens. They are doubtless situated in segment V. In one of the specimens examined entire under the microscope I noticed on one side in segment V a small cluster of granulated round cells attached to the posterior face of septum 4/5. I suppose that this was the ovary of that side.

The ovisac is single and extends through segment VI into segment VII. It is a backward pouch of septum 5/6. The sac contains one large ovum only, composed of a large mass of small eosin-staining spherical yolk granules, or one such large ovum together with a few small ova at its hinder end. The yolk mass in one specimen was 315μ in length and 112μ in width.

The female effluent apparatus was not observed.

The spermathecae are in segment IV. The ampulla is oval or spherical in shape with the short duct distinctly marked off from it by a constriction. The ampulla is 72μ long if oval, or 65μ in diameter if spherical. The duct is 27μ in height and 21μ in width.

Remarks.—The sexual organs are situated in segments IV and V, a fact which makes the position of this worm rather unique among the Naididae. It is now clear that this is not a species of *Naidium* under which it was provisionally placed by me in my original account (2). It differs markedly from *Naidium*, the reproductive organs of which have been recently described by Stephenson (25). A new genus has, therefore, to be erected for the reception of this species and I propose to name this genus *Stephensonia*.

Stephenson (20) has stated that in Naididae "there seems to be some connection between the position of the genital organs and the extent of the budding zone. The testis and spermathecae are formed in the last segment which is derived from the budding zone." In most genera of this family, the testes and spermathecae are situated in the *fifth* segment, and *five* segments are produced in the budding zone. In *Pristina* *seven* segments are produced in the budding zone, and the testes are in the *seventh* segment. *Naidium*, whose sexual organs were not known at the time the Fauna volume was written, is now seen to confirm the relation referred to. The present genus, in which the sexual organs have "jumped forward" one segment, establishes beyond doubt the relation between the budding zone and the position of the sexual organs. As I have already stated in my previous account (2) of this worm, *four* segments only are produced in the budding zone and testes and spermathecae are situated in the last segment derived from it.

Genus *Branchiodrilus* Mich.

Branchiodrilus menoni Steph.

Nagercoil. From soft mud in an old unused tank. April, 1927 Five specimens, two sexual.

Genus *Slavina* Vejd. em. Steph.*Slavina appendiculata* (Udek.).

Nagercoil, from very soft mud in an old irrigation tank, 1927 A single specimen, not sexual.

This species has hitherto been recorded in India from Calcutta, Lahore and the Andaman Islands. Its occurrence in the southernmost corner of India may be taken as an indication of its general distribution throughout the Indian area.

Genus *Dero* Oken.*Dero zeylanica* Steph.

Trivandrum. Collected on several occasions. Numerous specimens.
Nagercoil. April, 1927. Numerous specimens.
Chirayinkil. April, 1926. Numerous specimens.

This is the first time that this species is recorded from India. It was first described in 1913 by Stephenson (15) from specimens sent to him by Dr. Annandale from Ceylon. Of the six species of *Dero* that are known to occur in Travancore, I find this to be the commonest. Many of the tanks from which mud was examined for aquatic oligochaetes contain large numbers of this species.

The length of single individuals may reach up to 10 mm. and that of chains 14 mm. Number of segments 42-82, with always a few newly forming segments at the posterior end. The worm has a pale red colour with the branchial region at the posterior end rather whitish. When disturbed it swims like a *Nais* with an active serpentine movement. The worm does not generally live in tubes but specimens have often been found living within close fitting mucilaginous tubes to which sand particles and mud adhere.

The *dorsal setae* begin in segment VI and consist of double-pronged needles and hair setae. In the anterior segments there are three, rarely four, hair setae and as many needles per bundle. The hair setae and needles of a bundle alternate. The lengths of the setae in the specimens examined by me agree remarkably well with those noted by Stephenson in his specimens from Ceylon.

The *ventral setae* also agree closely with Stephenson's specimens. The number per bundle in segments II-V is four or five. The number in the anterior segments from the sixth segment onwards is four, five or sometimes six. The setae of segments II-V are less curved than those of the succeeding segments, vary in length from 114-123.5 μ , and have the nodulus at the middle of the shaft. "The outer prong is nearly twice as long as the inner and the prongs are about equal in thickness at the base." The setae from segment VI onwards vary in length from 85-95 μ and have the nodulus distal to the middle of the shaft (distal : proximal : : 19 : 26).

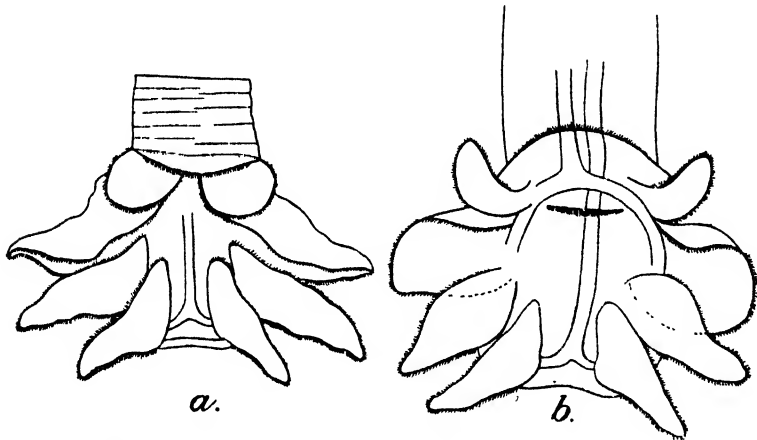
Branchiae.—There is a distinct pocket-like forward extension of the branchial fossa on the dorsal side of the posterior end of the alimentary canal. This diverticulum is clearly seen when the gills are in a retracted condition.

The first pair of gills, the smallest, are oval or circular in outline when fully expanded, and spring from the anterior end of the pocket-like diverticulum into which they can be completely withdrawn when the fossa is closed.

The second pair, which originate from the anterior part of the lateral wall of the fossa, are the broadest. These, like the first pair, are almost circular in outline but the anterior one-third is usually folded backwards over the rest.

The third and fourth pairs of gills spring from the floor of the branchial fossa. Each of these is a thin plate, roughly triangular in shape, and is attached to the floor by the short base, the two long sides being free. These gills sometimes stand out almost vertically but usually slant to one side or the other. It is only when they lie almost flat on one side that their real dimensions can be made out. When the gills are fully expanded their free ends project beyond the margin of the fossa.

The dorsal anterior margin of the fossa is ciliated but is not broken up to form secondary gills.



TEXT-FIG. 8.—*Dero zeylanica* : a., branchial region (diagrammatic) ; b., the same, diverticulum thrown forwards.

Internal anatomy.—There are no septal glands. Attached to the gut in segments III, IV and V are aggregations of flattened, circular, granulated cells of varying sizes. An average sized cell is 11μ in diameter.

There is a stomach, which occupies segments IX and X, or X only, or rarely VIII and IX. The stomach is lined by gland cells arranged in transverse rows. The narrow intervals between the rows give the stomachal wall a wrinkled appearance.

Chloragogen cells begin in segment VI. The first nephridium is in segment VIII. The dorsal blood vessel lies on the ventral side of the alimentary canal, a little to the left (cf. Stephenson, 15) of the middle line, as far as segment VI, in which it crosses over to the dorsal side. The ventral vessel is formed in segment II at the level of the ventral setae. There are four contractile vascular loops in segments VI-IX and sometimes an additional pair in segment IX.

The brain is widely indented in front and narrowly so behind. The indentation behind appears as a deep narrow fissure as in *D. limosa* and *D. austrina*. Scattered over the surface of the brain are very minute glistening particles.

Asexual reproduction.—Fission was observed in a large number of specimens and in almost all cases η was found to be 32, though rarely it was 31 or 33.

Sexual reproduction.—Several specimens were obtained on three occasions from laboratory culture in January 1926, May 1926 and May 1927.

The clitellum extends from the level of the setae of segment V or the level of the spermathecal apertures or sometimes a little in front of them to the level of the setae of segment VIII (=3).

The testes have disappeared in all the specimens examined. The sperm sac, a backward pouching of septum 5/6, is large and single and extends through segments VI-XI or XII, taking up nearly the whole body cavity in these segments.

The male funnels, which lie on the anterior face of septum 5/6, are cup-shaped and slightly deeper than wide (54 μ deep and 45 μ wide at the mouth). The vas deferens entering segment VI runs backwards, then upwards close to the atrial sac, and enters it a little above its middle. The vas deferens has no investment of peritoneal cells.

The atrium is a large, thin-walled, almost globular sac, in segment VI, filled with bundles of ripe spermatozoa. A short ejaculatory duct starts from its lower pole and opens to the outside in an invagination of the body wall. The duct is surrounded by a thick mass of small peritoneal cells.

The ovaries were not noticed in any specimen. The single ovisac, which is a backward pouching of septum 6/7, extends up to segment XV or XVI. The anterior part of the ovisac is occupied by the massive sperm sac, while the posterior portion is taken up by one large ovum which occupies three or four segments. The ovum in one specimen is 540 μ long and 180 μ wide at the anterior end and 115 μ at the posterior end. It is filled with spherical yolk granules except round the nuclear portion.

The spermathecae are in segment V. The ampulla is long, club-shaped and thin-walled. In several specimens examined entire under the microscope and in two of the four specimens sectioned the spermathecae enter the sperm sac and may extend up to segment VIII. Both spermathecae may enter the sperm sac or only one. The duct is 54 μ in height and 27 μ wide at its ental end. It gradually narrows towards the ectal end and opens to the outside a little in front of the level of the ventral setae.

There are no penial setae. The ventral setae of segment VI are lost when the specimens become sexually mature.

Degeneration of the anterior part of the alimentary canal observed in certain forms of Naididae occurs in this species also.

Remarks.—There appears to be no essential difference between the sexual organs in the two species *D. limosa* and *D. zeylanica*. In the present species the sperm sac extends backwards much more than in

D. limosa and the spermathecae, which are very long, enter the sperm sac.

Dero limosa Leidy.

Trivandrum. December, 1925 ; May, 1926 ; May, 1927. Numerous specimens.
Kottayam. May, 1927. Numerous specimens.

The worm is smaller, more slender and less active than *D. zeylanica* and can be easily recognised with a hand lens by the pinkish tinge on its body wall. The specimens from Kottayam were mostly living in tubes and the worm could be seen alternately putting out its posterior end and exposing the gills and then drawing it in and protruding the head after the fashion of *Aulophorus tonkinensis*.

Scattered in the epidermis are minute pigment granules of a pinkish colour but sometimes of an orange tint. There is an aggregation of these pigment particles along the dorso-anterior and lateral margins of the branchial fossa.

The lengths of the setae in the specimens from the two localities are shown in the table below :—

Trivandrum specimens—

| No. of segments . . . | II | III | V | VI | VIII |
|-----------------------|--------|--------|--------|-----|------|
| Needle setae . . . | .. | .. | .. | 63 | 70 |
| Hairs . . . | .. | .. | .. | 175 | 200 |
| Ventral crotchets . . | 95-104 | 95-104 | 95-104 | 72 | 81 |

Kottayam specimens—

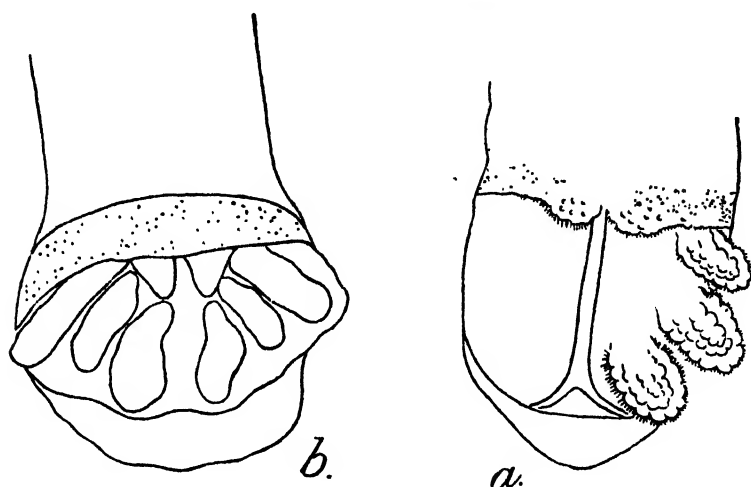
| No. of segments . . . | II | III | V | VI | VIII | XVII |
|-----------------------|-----|-----|-----|-----|------|------|
| Needle setae . . . | .. | .. | .. | 72 | 72 | 70 |
| Hairs . . . | .. | .. | .. | 200 | 220 | 200 |
| Ventral crotchets . . | 108 | 108 | 108 | 90 | 90 | 90 |

Branchiae.—Taking the branchial arrangement, the present specimens may be classed into two groups.

In the first group, which includes the majority of my specimens (text-fig. 9a), there is a slight narrow pocket-like space between the dorso-anterior margin of the fossa and the terminal portion of the alimentary canal. The dorso-anterior border is cut up in the middle and gives rise to a pair of secondary gills (projections from the margin of the fossa). A second pair of gills, as long as the gills from the floor of the fossa, originate from the narrow pocket-like space near the lateral angle. These gills, not being “projections from the margin”, may be looked upon as ‘true’ gills. The two remaining pairs spring from the floor of the fossa. Thus in the majority of the specimens, there are three pairs of “true” gills and one pair of “secondary” gills.

In the remaining few specimens (text-fig. 9b), which constitute the second group, there is a distinct forward extension of the branchial fossa as in *D. zeylanica*. In this group all the four pairs are true gills, the first pair springing from the diverticulum, the second pair from the anterior lateral angles of the fossa and the third and fourth pairs from the floor of the fossa.

Stephenson in the Fauna volume remarks that in his specimens from Lahore "the dorsal margin of the fossa was more cut up than usual,



TEXT-FIG. 9.—*Dero limosa* : Branchial region : a., one pair of secondary and three pairs of true gills ; b., four pairs of true gills (preserved specimen).

apparently, and gave the appearance of two pairs of secondary gills." Stephenson's specimens appear to me to be intermediate between the type-form of the species (with one pair of secondary and two pairs of true gills) and the first group of my specimens (with one pair of secondary gills and three pairs of true gills).

The dorsal vessel occupies the same position as in *D. zeylanica*, i.e. ventral, a little to the left of the middle line. There are four pairs of contractile vascular loops in segments VI-IX and not in VII-X as in Stephenson's specimens from North India.

Fission was noted in a number of individuals and η was found to vary from 19-24, 19 and 20 being more general than 21-24.

***Dero austrina* Steph.**

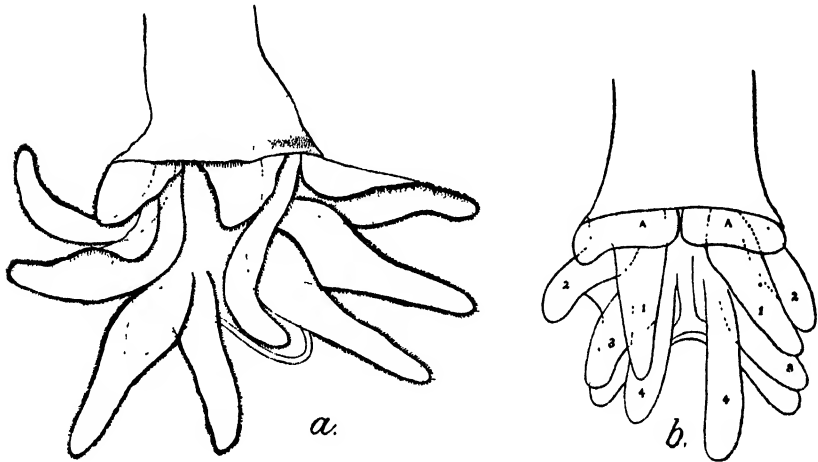
Trivandrum. May, 1926 ; June, 1927. Numerous specimens.

Length of specimens 10-18 mm. The largest number of segments counted is 106. A protective coat of hardened mucus is present in most individuals.

The setae agree closely with Stephenson's account of them. The ventral setae are only 4-5 per bundle in the anterior region up to segment IX, then the number diminishes to 3 or 4 and more posteriorly sinks to 2 or 3.

Gills.—In all the specimens examined by me there are four pairs of true gills and one pair of secondary gills (text-fig. 10a, b). The secondary gills in this species correspond to the first pair of gills in *D. zeylanica*. In *D. zeylanica* they originate from the dorsal extension of the

branchial fossa but here on the other hand, though they can be retracted slightly beneath the anterior margin, they appear to be continuous with it, when the fossa is fully expanded. All the four pairs of true gills are of about the same length when fully extended and project far beyond the margin of the fossa. The first pair arise in front of the secondary gills near the lateral wall. The second pair spring from the lateral wall of the fossa. These have the anterior one-third of the basal half folded backwards. The third and the fourth pairs originate from the floor of the fossa.



TEXT-FIG. 10.—*Dero austrina*: Branchial region: a., live specimen; b., preserved specimen.

The ventro-posterior border of the branchial fossa is cleft in the form of a broad inverted V and produced on each side into a short palp-like projection. Each palp is 110 μ long and as much wide in the middle and narrows a little towards the rounded tip. The palps are non-vascular and non-contractile. When the gills contract the distal half of each palp folds obliquely inwards over them.

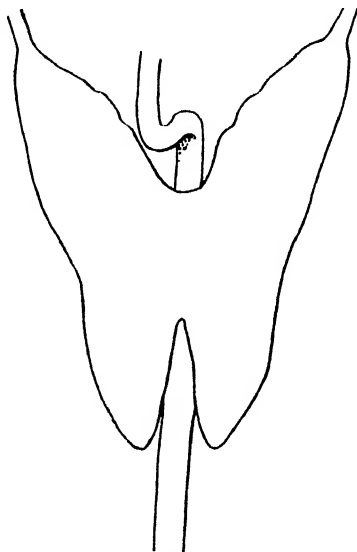
Septal glands are present in segments IV and V and appear to have the same structure as in *Aulophorus*. They are very vascular being supplied by branches of the dorsal vessel.

The stomach extends through 2 or 3 segments from segment X or XI and is slightly constricted by the septa. The stomach can be distinguished from the wide intestine that follows it by the lining of gland cells arranged in transverse rows as in the other species of *Dero*.

The brain is widely indented in front and narrowly cleft behind (text-fig. 11). The narrow posterior fissure extends forwards as far as the middle. A number of very minute glistening particles are seen aggregated together a little to the left side of the termination of the posterior fissure.

Asexual reproduction.—Though large numbers of specimens were examined asexual reproduction was observed in two individuals only. One of these had 106 segments and was dividing between the 53rd and 54th segments (exactly at the middle). The other had 77 segments

and was dividing between the 45th and 46th segments. Gills were developed at the posterior end of the anterior individual in each case but no new segments were formed at the anterior end of the posterior individual. The individuals were seen to separate in this condition



TEXT-FIG. 11.—*Dero austrina* : Brain.

and the new segments (five) at the anterior end of the posterior animal were produced after separation. Several individuals in which gills were present at the hinder end but in which the first four setigerous segments were in different stages of formation were obtained. This proves beyond doubt that while the regeneration of the hinder end of the anterior animal takes place *before* separation, the formation of the 'head' segments of the posterior animal takes place only *after* separation.

***Dero pectinata*, sp. nov.**

Trivandrum. 12-V-1927. Numerous specimens.

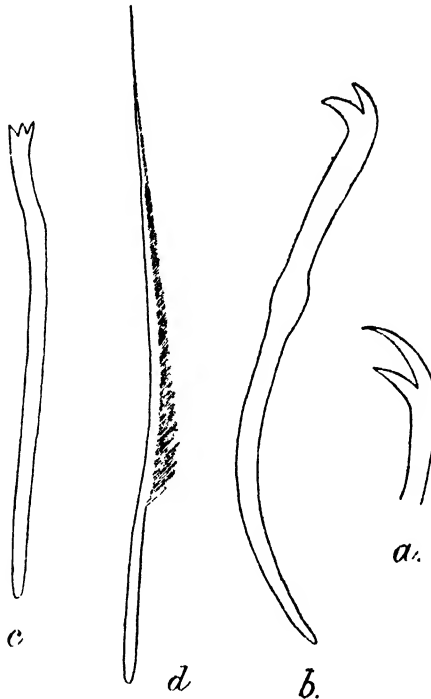
External characters.—This is a very minute and slender worm, single individuals measuring 2 mm. or less in length when living and chains of two very slightly longer. Number of segments 19-25. The *prostomium* is bluntly conical with a few hair-like protoplasmic processes along the margin.

The *ventral setae* begin in segment II and consist of bifid crotchets. The setae of segments II-V are much longer than those of the succeeding segments and are much less curved. The nodulus is distinctly proximal to the middle of the shaft (distal : proximal :: 36 : 22) and the outer prong (text-fig. 12a) is longer than, though of the same thickness as the inner prong. The number of setae per bundle is 4.

The *ventral setae* from segment VI onwards have the nodulus distal to the middle of the shaft (dist. : prox. :: 10 : 20) and have the outer

prong (text-fig. 12*b*) slightly shorter and less thick than the inner. The number per bundle is four except in a few posterior segments in which the number diminishes to 3 and then to 2.

The dorsal setae begin in segment VI and each bundle consists of one hair seta and one needle. The needle seta (text-fig. 12*c*) has an indistinct nodulus distal to the middle of the shaft (dist. : prox. : : 5 : 23). The shaft is straight up to the nodulus, beyond which it is slightly curved like a bayonet. The tip of the needle is divided into three equal prongs. The prongs are distinct only under the oil immersion lens. The hair



TEXT-FIG. 12.—*Dero pectinata* : *a.*, distal end of ventral seta of segment III, \times *ca.* 2820 ; *b.*, ventral seta of posterior segment, \times *ca.* 2820 ; *c.*, dorsal needle, \times 2480 ; *d.*, hair seta, \times *ca.* 1700.

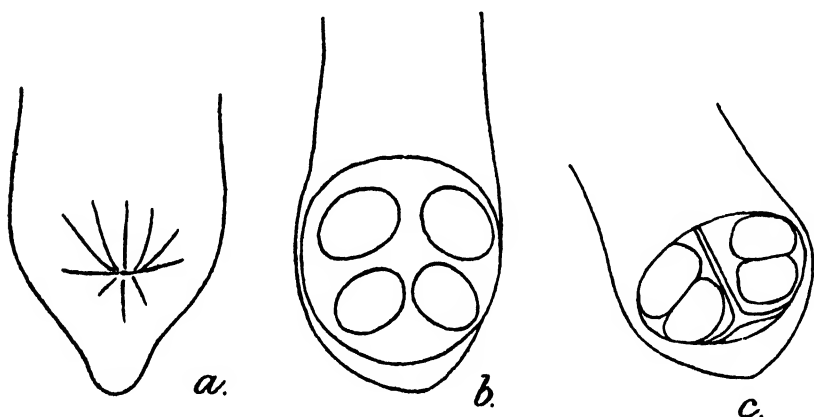
seta (text-fig. 12*d*) has a slight sickle-shaped curve and is ornamented on the convex border with a row of closely-set oblique barbs giving the seta the appearance of a feather. The barbs begin at the commencement of the curve and getting gradually shorter towards the tip cease a little distance behind it.

Lengths of the setae—

| No. of segments | | II to V | VI | XII |
|-------------------|-----------|---------|----|-----|
| Needles | | .. | 37 | 37 |
| Hairs | | .. | 78 | 78 |
| Ventral crotchets | | 70—78 | 39 | 39 |

Gills.—The branchial fossa at the posterior end is generally kept completely closed (text-fig. 13*a*) when the worm is under the microscope,

and one is tempted to put it down as a species of *Nais*. When fully opened, the fossa is seen to be a wide shallow circular cup (text-fig. 13*b*) with a rounded ventro-posterior border. Springing from the floor of the fossa are two pairs of small, knob-like, almost rounded gills, covered with a layer of pear-shaped cells. The gills do not project beyond the margin of the fossa even when they are fully extended. The dorsal anterior margin is straight and ciliated and is not cut up to form secondary gills.



TEXT-FIG. 13.—*Dero pectinata*: Branchial region. a., Branchial fossa closed; b., fossa fully open (semi-diagrammatic); c., fossa open (preserved specimen).

Internal anatomy.—Septal glands, consisting of masses of glassy transparent cells, are present in segments III-V.

There is a stomachal dilatation in segment VIII. Chloragogen cells begin in segment VI.

The dorsal vessel lies on the ventral side of the alimentary canal, to the left of the middle line. It crosses over the oesophagus and comes to lie dorsally in segment VI. There are only two pairs of contractile vascular loops in segments VI and VII.

There are no coelomic corpuscles.

The first nephridium is in segment VIII. The neck of the funnel of each nephridium on passing through the septum into the segment behind widens to form a non-ciliated, non-glandular, bladder-like bag which narrows posteriorly and forms the duct. The duct is ciliated and has a few windings.

The cerebral ganglion is deeply indented both in front and behind.

In asexual reproduction $\eta=14$ or 15. The individuals sometimes separate before the anterior segments of the posterior animal are fully formed.

A single sexually mature specimen was obtained. The clitellum in this specimen extends over segments V-VII ($=3$). The ventral setae of segment VI are absent. I hope to give a complete account of the sexual organs of this species when I have secured a few more sexual specimens.

***Dero palmata*, sp. nov.**

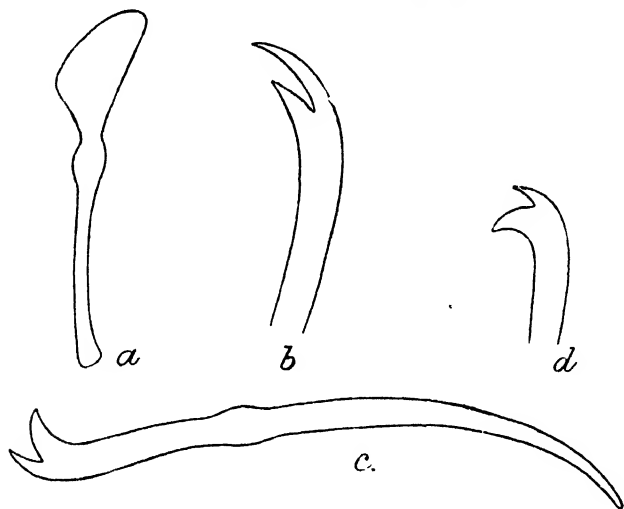
Trivandrum. 14-V.1927. A few specimens.

External characters.—Length of single individuals 2.5 to 3 mm. and of chains a little more than 3 mm. Number of segments 19-33.

The prostomium is bluntly conical with an almost rounded anterior margin.

The dorsal setae begin in segment VI and consist of one palmate needle and one hair seta per bundle. The palmate seta (text-fig. 14*a*) is 52 μ long with a straight shaft and the nodulus distal to the middle of the shaft (dist. : prox. : : 15 : 25). Immediately beyond the nodulus the shaft expands to form the 'palm,' which resembles that of the dorsal needle of *Aulophorus tonkinensis* and is 13.5 to 15 μ wide at its distal end. The two lateral margins of the palm are slightly raised. The hair seta is without any ornamentation.

The ventral setae of segments II-V are about twice as long as those of the succeeding segments. The outer prong (text-fig. 14*b*) is twice as long as the inner and the nodulus is proximal (dist. : prox. : : 30 : 20). The number per bundle is four. The ventral setae from segment VI onwards have the nodulus distal (dist. : prox. : : 15 : 23). The outer prong (text-fig. 14*c, d*) is thinner and shorter than the inner prong. The



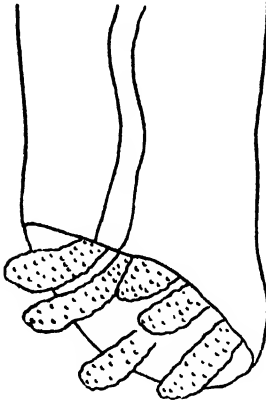
TEXT-FIG. 14.—*Dero palmata* : *a.*, palmate seta, \times ca. 1520 ; *b.*, distal end of ventral seta of segment III, \times ca. 2820 ; *c.*, ventral seta of posterior segment, \times ca. 2400 ; *d.*, the same, distal end.

number per bundle is 4 in the anterior segments, while posteriorly it diminishes to 3 and then to 2.

Lengths of setae---

| No. of segments | II to V | VI | XII |
|-------------------|---------|------|-----|
| Palmate needles | .. | 52 | 52 |
| Hair setae. | .. | 90 | 90 |
| Ventral crotchets | 90 | 49.5 | 48 |

Gills.—There are three pairs of true gills, short and finger-shaped (text-fig. 15). The first pair originate from the lateral walls of the fossa and the second and third pairs from the floor of the fossa. When the gills are fully extended they project beyond the margin of the fossa. The ventro-posterior border of the fossa is rounded and the dorso-anterior margin is straight and ciliated. There are no secondary gills.



TEXT-FIG. 15.—*Dero palmata* ♂
Hinder end of a preserved specimen to show branchial region, slightly flattened by pressure.

Internal anatomy.—Chloragogen cells begin in segment VI. There is a stomachal dilatation in segment VIII.

The dorsal vessel occupies the same position as in the other species of the genus. The ventral vessel is formed at the level of the ventral setae in segment II. There are three pairs of contractile vascular loops in segments VI, VII and VIII; the loops in segment VI are less stout than those of the two succeeding segments.

There are no coelomic corpuscles.

The first nephridium is in segment VIII. The brain is deeply indented in front and less so behind.

Fission was observed in six specimens. In three of these η was 14 and in three others 15.

***Dero niveum*, sp. nov.**

Trivandrum. 24-V-27. Several specimens.

External characters.—Length of single individuals 2.5 to 3.5 mm.; of chains 5 mm. Number of segments 23-30.

Prostomium more or less rounded.

The dorsal setae begin in segment VI and consist of one needle and one hair seta per bundle. The shaft of the needle (text-fig. 16a) is straight with an indistinct distal nodulus beyond which is a slight sickle-shaped curve. The tip is bifid and the prongs minute. The hair seta is smooth, without ornamentation.

The ventral setae of segments II-V are longer and less curved than those of the succeeding segments. The outer prong (text-fig. 16b), which has about the same thickness at the base as the inner, is longer than it and the nodulus is proximal (dist. : prox. :: 28 : 17). The number per bundle is four.

The ventral setae from segment VI onwards have the nodulus distal (dist. : prox. :: 17 : 23) and the prongs are equal in length (text-fig. 16c, d).

Lengths of setae—

| No. of segments | . | . | . | . | . | II to V | VI | XII |
|-------------------|---|---|---|---|---|---------|-------|-------|
| Needles | . | . | . | . | . | .. | 45.5 | 48 |
| Hair setae | . | . | . | . | . | .. | 108.0 | 118 |
| Ventral crotchets | . | . | . | . | . | 81-84 | 52-54 | 52-58 |



TEXT-FIG. 16.—*Dero niveum*: a., dorsal needle \times ca. 3000; b., distal end of ventral seta of segment III; c., ventral seta of segment VI, \times ca. 1860; d., distal end of the same, more magnified.

The branchial region (text-fig. 17 a, b) is conspicuous.

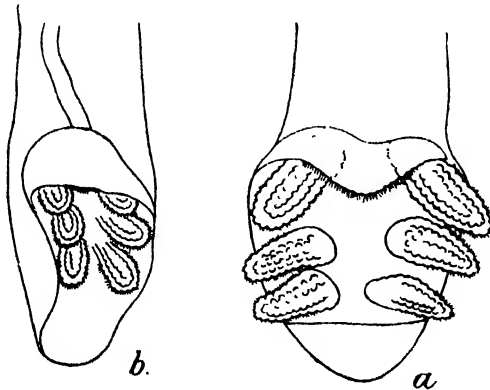
The fossa is prolonged anteriorly into a pouch or diverticulum above the terminal portion of the intestine as in *D. zeylanica*. The ventro-posterior border of the fossa is rounded and the dorso-anterior margin is either straight or produced into a median triangular lobe. There are three pairs of true gills. The most anterior of these originate from the diverticulum into which they can be completely withdrawn when the fossa is closed. The second and third pairs spring from the floor of the fossa.

Internal anatomy.—Chloragogen cells begin in segment VI. There is a stomachal dilatation in segment VIII. There are no coelomic corpuscles. The first nephridium is in segment VIII.

The dorsal vessel occupies the usual position on the ventral side of the alimentary canal to the left of the middle line. There are three pairs of contractile vascular loops in segments VI, VII, and VIII; the loops in VII are much stouter than the other two.

The brain is indented both in front and behind.

Asexual reproduction was observed in eleven specimens, the value of η was 14



TEXT-FIG. 17.—*Dero niveum*: Branchial region. a., gills expanded (diagrammatic); b., gills (preserved specimen).

in one specimen, 15 in one, 16 in 8 specimens and 17 in one. Sexual organs were not present in any of the specimens.

NOTE ON THE GENUS *Dero*.

As a result of the discovery of four new species since the "Fauna" volume by Stephenson (20) was published, the diagnosis of the genus as stated by him has to be slightly altered as follows:—

"Prostomium well marked, rounded. No eyes. Ventral bundles of segments II-IV or II-V longer than the others. Dorsal bundles beginning in IV, V or VI with hair setae and needles. The needles may be bifid, *pectinate* or *palmate*. Hinder end with branchial fossa, with gills but no palps. Genital organs in general resemble those of *Nais*; sperm sac single; its hinder end encloses the ovisac; spermathecae in V may enter sperm sac. Alimentary canal degenerates in the fully mature (sexual) animal."

The chief diagnostic characters of the Indian species of the genus may be stated as follows:—

1. *Dero zeylanica* Steph.

Dorsal setae begin in VI, 3 bifid needles and 3 hairs per bundle in anterior segments. Four pairs of true gills. Stomach in IX and X. Vascular loops, four pairs in VI-IX. η =31-33, usually 32.

2. *Dero limosa* Leidy.

Dorsal setae begin in VI, 1 bifid needle and 1 hair seta per bundle. 2, 3 or 4 pairs of true gills and 1 pair of secondary gills. Stomach in IX-X. Four pairs of vascular loops in VI-IX. η =19-24.

3. *Dero austrina* Steph.

Dorsal setae begin in IV, 1 bifid needle and 1 hair seta per bundle. 4 pairs of true gills and 1 pair of secondary gills. Stomach in X-XII. Vascular loops in V-XIV. η =34-53.

4. *Dero pectinata*, sp. nov.

Dorsal setae begin in VI, one pectinate (trifid) needle and one plumose hair per bundle. Two pairs of true gills, rounded and knob-like. Stomach in VIII. Two pairs of vascular loops in VI-VII. η =14 or 15.

5. *Dero palmata*, sp. nov.

Dorsal setae begin in VI, one palmate needle and one hair seta per bundle. Three pairs of true gills. Stomach in VIII. Three pairs of vascular loops in VI-VIII. η =14 or 15.

6. *Dero niveum*, sp. nov.

Dorsal setae begin in VI, one bifid needle and one hair seta per bundle. Three pairs of true gills. Stomach in VIII. Three pairs of vascular loops in VI-VIII. η =14-17 (usually 16).

Key to the Indian species of *Dero*.

- | | |
|--|-----------------------|
| 1. Dorsal setae begin in segment IV | <i>D. austrina</i> . |
| Dorsal setae begin in VI | 2 |
| 2. Dorsal needles palmate | <i>D. palmata</i> . |
| Dorsal needles pectinate | <i>D. pectinata</i> . |
| Dorsal needles bifid | 3 |
| 3. Dorsal bundles of 3 needles and 3 hairs | <i>D. zeylanica</i> . |
| Dorsal bundles of one needle and one hair | 4 |
| 4. Stomach in VIII; η =14-17 | <i>D. niveum</i> . |
| Stomach in IX or IX-X; η =19-24 | <i>D. limosa</i> . |

Genus **Aulophorus** Schmarda.**Aulophorus furcatus** (Oken).

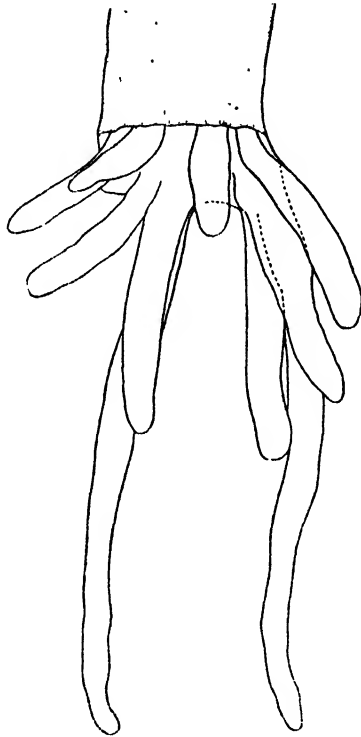
Tanks in Trivandrum. Collected on several occasions.

The specimens that occur here have three pairs of true gills only.
No accessory gills are present.

Aulophorus michaelsoni Steph.

Trivandrum. December, 1925. A few specimens.

The palps vary in length from 332-840 μ .
 $\eta=28$ (in four specimens).



TEXT-FIG. 18.—*Aulophorus michaelsoni*: Hinder end (preserved specimen).

The first nephridium is in segment XI.

Four pairs of vascular loops in segments VI-IX.

Family TUBIFICIDAE.

Genus **Aulodrilus** Bretscher.**Aulodrilus trivandranus** Aiyer.

Nagercoil. 16-IV-1927. Numerous specimens, three sexual.

Family ENCHYTRAEIDAE.

Genus *Enchytraeus* Henle.*Enchytraeus barkudensis* Steph.

Kovilam, 7 miles south of Tiruvandrum. From wet sand by the side of a rock, occasionally washed by the tide. Four specimens, one fully mature. The specimens occurred along with *Pontodrilus bermudensis*

Family MONILIGASTRIDAE.

Genus *Moniligaster* E. Perr.*Moniligaster deshayesi* E. Perr.

(Plate I, figs. 5, 6, 7, 8 9.)

Tenmalai, Travancore. 11-IX-26; 15-X-26; 5-VII-27. Four specimens, one sexually mature.

Two of the specimens were found gliding along the roadside during the rains and two others were dug up from the ground. I add a few notes on certain features of these specimens with an account of the glands surrounding the vas deferens in this species.

External characters.—The length varies between 140 and 150 mm. Diameter 6 mm. Number of segments 136-156. There is no secondary annulation. Colour during life, an iridescent dark blue dorsally, somewhat lighter ventrally. There is a broad greyish band along each side of the body. The two lateral bands extend ventralwards and fuse in front of segment XIII so that the ventral side of the anterior part of the body is of the same colour as the bands themselves.

The setae are absent in segment II. Both ventral and lateral setae are present from segment III backwards. The lateral setae of each side are in the middle of the lateral band mentioned above. The setal interval *au* is only very slightly less than *bc*, and *dd* is exactly half the circumference.

The clitellum was fully developed and well marked in one specimen. It extends over segments X-XIII (=4). The intersegmental grooves are intact. The male pores in $\frac{1}{1}$ are midway between *b* and *c*. The female pores are in $\frac{1}{1\frac{1}{2}}$ in *ab*. The spermathecal apertures are in $\frac{7}{8}$ in *cd*.

Internal anatomy.—The gizzards are five in number, in XV-XIX, in all the four specimens. The testis sacs, suspended from septum 9/10, are confined to segment X, except in the case of the single mature specimen in which the anterior third of the left sac projects into segment IX and is slightly constricted by the septum. The sacs are oval or rounded bags with the posterior part distinctly rounded. The sacs are filled with a loose spongy tissue composed of cells with narrow elongate nuclei and with different stages of the developing sperms. A mass of ripened spermatozoa is seen at the mouth of the funnel (Plate I, fig. 5).

The funnel, which is fused with the wall of the sac, is situated at the anterior side close to the testis, and is 500 μ in width at its broadest part. It is made up of a single layer of columnar ciliated cells.

The testis, composed of 5 or 6 lobes, is suspended from the anterior wall of the testis sac, close to the funnel. (In plate I, fig. 5 a small part of a testis lobe is seen on the left of the funnel.)

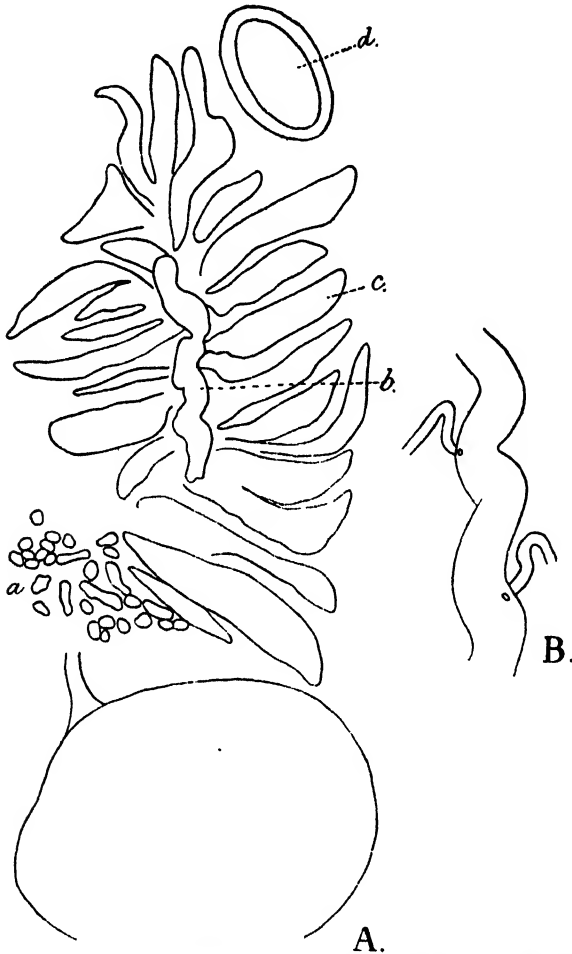
The vas deferens at its beginning is about 50μ in diameter and the epithelium is strongly ciliated. The tube soon gets convoluted and the numerous coils are massed together into one or sometimes into two bunches (Plate I, fig. 6) on the ventral side of the anterior part of the testis sac. Attached by membrane to the anterior side of the testis sac is a cluster of leaf-like bodies (Plate I, fig. 7); this structure is dealt with in detail below. The vas deferens enters this cluster and emerges from its anterior end as a wide tube, about 150μ in diameter. It now passes into segment IX, curves round the ventral limb of the heart in this segment and passing ventrally to it returns to segment X, runs backwards along the side of the long prostate, and enters it near its ental end (Plate I, fig. 6).

The leaf-like bodies referred to above are, I believe, a feature not only of the present specimens but of the species. Perrier, who described this species more than 50 years ago, appears to have noticed this structure. As I am unable to consult Perrier's original account and figures of this worm, I quote below the following from Beddard's monograph. "The sperm duct is figured and described by Perrier as possessing a quantity of little leaf-like bodies attached to it." Beddard, however, summarily disposes of Perrier's observation with the remark "these can be nothing else than the folds of the sperm duct, which in this, as in other species of the genus, is extremely convolute."

Michaelsen, who has recorded the occurrence of this species in Travancore, does not in his account (8) make any mention of these bodies. Stephenson records the species from two localities in the Cochin State (20) and later in 1926 from Courtallum, Tinnevely District, about 15 miles north of Tenmalai, where my specimens were obtained. He too appears to have overlooked the structure. In his notes on the specimen from Courtallum (24) Stephenson says "The anterior portion of the testis sac is much cut up, while the posterior portion constitutes a rounded bag." The leaf-like bodies which in mature specimens are of the same pale flesh colour as the testis sac are compactly arranged at the anterior end of the sac, the outer ones slightly overlapping the inner. I suspect that Stephenson has mistaken the cluster of appendages as a part of the testis sac itself and has referred to it as "the much cut up anterior portion of the testis sac."

Each body is broad and leaf-like, thicker at the base than at the free margin and is made up entirely of an extremely convoluted fine tubule (Plate I, figs. 8 and 9), the convolutions of which are pressed together into a plate-like body. The tubule is about 25μ in diameter and is non-ciliated. The basal parts of the bodies are in contact and consequently in dissections a 'fleshy' central core is seen in the cluster. The vas deferens on entering this cluster becomes wider and non-ciliated, and taking a slightly wavy course through the 'fleshy' core emerges from it at its anterior end. The vas deferens is thus surrounded by these leaf-like bodies.

By simple teasing under the dissecting binocular it is seen that each leaf-like body (each mass of tubules) opens into the vas deferens by a short duct. Text-fig. 19-B shows a small portion of the vas deferens with two such ducts opening into it.



TEXT-FIG. 19.—*Moniligaster deshayesi* : A., Longitudinal section of testis sac and glands ; a., b., vas deferens ; c., glands ; d., heart. B., portion of vas deferens with ducts of glands entering it.

These bodies are highly vascular, being supplied by a branch of the intestinal commissure in segment X. Both transverse and longitudinal series of sections of the testis sac with the attached appendages were prepared, and the points made out by means of dissection were fully confirmed. There is no doubt that these bodies are glands discharging their secretion into the vas deferens. The nature of the secretion is worth investigation since this species appears to stand unique not only among the Moniligastridae but among the order Oligochaeta in the possession of such glands in connection with the male genital duct.

The atrial glands are contained in segment VII close to septum 7/8. Each is composed of two distinct portions, one of which is anteriorly situated and is more or less hemispherical in shape and reaching only to less than half the height of the other. The latter is oval with the ental portion broad and rounded. Each part has its own muscular duct. The ducts of the two parts join in a Y-like manner to form a common duct. The spermathecal duct opens into this common duct just where the latter is formed.

Genus *Drawida* Mich.

Drawida barwelli (Bedd.) var. *impertusa* Steph.

(Plate II, figs. 10, 11, 12, 13.)

Thiruvella, from the edge of a tank. 15-XI-26. Six specimens.

Vandiperiyar, from the edge of a streamlet. 24-XII-26. Eight specimens.

As the variety has till now been recorded only from Bombay I add an account of the present specimens from Travancore.

External characters.—Length 58-65 mm., diameter 2.5-3 mm. Number of segments 136-140. The colour of this worm during life is chocolate, the ventral side being paler than the dorsal. The body wall is thin and some of the internal organs such as the testis sacs, ovary and the dorsal blood vessel are just visible through it.

Dorsal pores are absent.

The setae are very closely paired. In the middle of the body *aa* is equal to *bc* and *dd* is slightly greater than half the circumference. Setae are present in segment II.

The clitellum is of a pale brick-red colour in preserved specimens and extends over segments X-XIII. The segments are swollen but the inter-segmental grooves are not obliterated.

The male pores are in furrow $\frac{1}{11}$, midway between the lines of setae *b* and *c*. The pores are situated in transversely elongated oval whitish papillae (Plate II, fig. 10) separated by an interval equal to the length of a papilla. Each papilla is broad on the outer side and narrow on the inner side and extends from the line of setae *d* to the line of setae *a*. The groove $\frac{1}{11}$ cuts through the middle of each papilla and divides it into two equal halves. The minute male pore itself is surrounded by a circular puckered lip. On segment X are a pair of ovoid papillae, each extending from the anterior margin of the male papilla to furrow $\frac{9}{10}$. The longitudinal axis of each of these papillae is slightly raised into a whitish ridge. The female pores are in $\frac{1}{12}$ in *ab*. The spermathecal apertures are in $\frac{2}{3}$ in *cd*.

Internal anatomy.—In three specimens dissected from the batch from Thiruvella there are only three gizzards, in segments XIII-XV. The specimens from Vandiperiyar have four gizzards, in segments XIV-XVII. The gizzards are separated by vascular thin-walled intervals.

The testis sacs are ovoid, pear-shaped or irregular. The anterior half of each sac may project into segment IX or only very little.

The prostate (Plate II, fig. 13) is flattened and circular and is sessile on the parietes. It is covered with a layer of finely granulated gland

cells. The vas deferens enters it on its anterior border a little internal to its longitudinal axis.

A completely closed ovarian chamber is formed by the approximation of septa 10/11 and 11/12. The ovary was so well developed in one specimen that the mid-dorsal portion of the chamber was considerably swollen and projected into segment X in front and extended backwards into segment XII. The ovisacs are confined to segment XII or may extend into XIII.

The spermathecal ampulla (Plate II, fig. 11) in segment VIII is ovoid and of a chalky white colour. The duct, after much coiling behind septum 7/8, passes down it to open to the outside in furrow 7. The duct gets slightly thickened at its ectal end (Plate II, fig. 12).

There is no atrium.

***Drawida ghatensis* Mich.**

Mukkunni Reserve Forest. 7-IX-22; 26-XI-22; 1-VII-26. Ten specimens.
Thiruvella. 15-XI-26. Three specimens.

On the first occasion when the specimens were collected the ground was perfectly dry and the worms lay in the hard soil under granite blocks nicely coiled up in little hollows lined by mucus. When the granite stone is lifted and the worm in the hollow is disturbed, it jumps out and runs on the dry ground like a snake with an agility that is astonishing for an earthworm. Though there is not much of the slimy secretion on the body a specimen caught in the hand manages to slip out with remarkable ease. The colour during life is an iridescent blue on the dorsal side and pale grey ventrally.

Internal anatomy.—The gizzards are five in number, in segments VI-XX in the specimens taken from Mukkunni, while they are in segments XIV-XVIII in the batch from Thiruvella.

The atrium differs in the two batches of specimens. In the lot from Mukkunni the atrium is bilobed, the lobes placed one behind the other. The ectal half of the atrium is embedded in the body wall. The shiny spermathecal duct enters the atrium on its inner side (side facing the gut), a little below the depression between the lobes. The cavity of the atrium is also bilobed. In the specimens from Thiruvella the atrium is a teat-like sac with a long narrow U-shaped cavity. The basal third of the atrium is embedded in the parietes. The spermathecal duct joins the atrium on its inner side and enters it close to the body wall.

***Drawida pellucida* (Bourne) f. *typica*.**

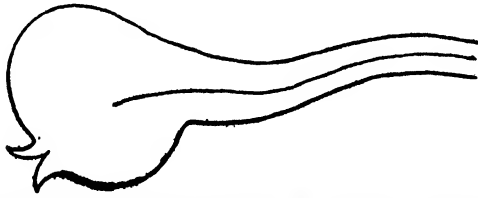
Ponmudi, 3,000 ft. September, 1922. A few specimens.

External characters.—Length 75-95 mm. Diameter 4 mm. Number of segments 145-155. The dorsal side of the worm (a fourth of the circumference) is light dark brown; the ventral and ventro-lateral sides up to *d* are of the same colour as the dorsal side. There is a pale grey band on each side extending from *d* to the lower edge of the dorsal brown area.

The prostomium is prolobous.

Setae are present in II,

The male pores are narrow longitudinal slits in $\frac{1}{11}$, rather nearer *c* than midway between *b* and *c*.



TEXT-FIG. 20.—*Drawida pellucida f. typica* : Atrium.

The spermathecal pores are in line with *c*.

Internal anatomy.—The gizzards are five in number in XIV-XVIII or XV-XIX or XVI-XX.

The testis sacs are confined to segment X, suspended by septum 9/10, by a narrow neck.

The atrium in segment VII is a small simple rounded dilatation of the end of the spermathecal duct and is embedded in the parietes close to septum 7/8.

Remarks.—The present specimens appear to me to be identical with the type-form of the species since the male pores are between *b* and *c* and an atrium is present. They differ from the type in the presence of setae in segment II and in the male pores being nearer *c*. But these points by themselves may not be sufficient to rank them as a new variety.

***Drawida travancorensis* Mich.**

Tenmalai, from the edge of river. 11-IX-26. Eight specimens.

Vombayam. 5-XII-26. Five specimens, three sexual.

I add a few notes on certain features of the present specimens.

Length 90-140 mm. Diameter 3.5-4 mm. Number of segments 132-186. Colour during life dark grey above, paler ventrally.

The prostomium is prolobous, long and conical. It gets considerably retracted when the worms are killed.

The male pores are narrow, transversely elongated slits, in $\frac{1}{11}$ about midway between *b* and *c*. The pores are bordered in front and behind by a thickened glandular lip the margin of which is much cut up.

The female pores are minute in $\frac{1}{12}$ in line with *b*.

Internal anatomy.—The gizzards are two in number in segments XIII-XIV, that in XIV being much larger and almost spherical.

The testis sacs in three of the four specimens dissected project into both IX and X and are not constricted by the septum. In the fourth specimen one sac projects slightly into segment IX and the other extends backwards a little beyond the ovarian chamber.

The prostates are pear-shaped with a 'furry' surface. The ectal end of the prostate is rounded and fits into a cup-shaped depression in the body wall. Strong muscle bands run transversely across the parietes in this region. The vas deferens enters the prostate a little below its ental end.

The atrium in segment VII has the shape of an inverted flask, the neck being half as wide as the rounded body. The spermathecal duct enters the atrium at its ectal end. In one specimen, while the right atrium was of the usual shape, the left was bilobed in the longitudinal direction, the septum 7/8 cutting the atrial sac into two halves.

***Drawida circumpapillatus*, sp. nov.**

(Plate II, figs. 14, 15.)

Nedumangad. 10-IX-26. Four specimens, two of which were sexual.
Vembayam. 5-XII-26. Four specimens, three sexual.

External characters.—The length varies between 40 and 45 mm. Diameter of body 1.5 mm. Number of segments 128-148.

The prostomium is prominent during life and is probolous. It gets very much contracted on killing the worms and is seen in preserved specimens as a small lobe under the first segment.

Dorsal pores are absent.

The setae are small and very closely paired. In the middle of the body *aa* is equal to or very slightly less than *bc*, and *dd* is half the circumference. Setae are present on segment II.

The clitellum is well marked and extends over segments X-XIII. This region is conspicuously swollen and is of a much paler colour than the rest of the body. The male pores are in furrow $\frac{1}{2}$ in *ab*, each being situated on a minute conical elevation in the centre of a large neatly circular papilla (Plate II, fig. 14). The papillae in some specimens almost touch each other in the mid-ventral line and in others are separated only by a narrow interval. Each papilla extends outwards to about half *bc* and anteriorly and posteriorly as far as the setal zones of the 10th and 11th segments respectively. The papillae have a narrow whitish border and in some specimens the outer edge stands out from the body wall and not touching it.

The female apertures are not distinguishable.

The spermathecal pores are in furrow $\frac{2}{3}$ in *ab*.

Internal anatomy.—Septa 5/6-8/9 are thickened.

The gizzards are three in number in segments XII-XIV or XIII-XV ; none being very large.

The last hearts are in segment IX.

The excretory system is meganephridial.

The testis sacs are large ovoid sacs, yellowish in colour, in segment X, not projecting or only slightly into segment IX ; in the latter case, not constricted by the septum. The anterior portion of the vas deferens lies on the anterior face of septum 9/10 in segment IX, where it twines round the heart once or twice.

The prostates are in segment X. They are whitish in colour, short, cylindrical and slightly curved (Plate II, fig. 15). The surface is 'furry' or papillose, being densely covered with large, finely granulated gland cells. The vas deferens enters the prostate on its anterior side near the ectal end.

A conspicuous ovarian chamber is formed by septa 10/11 and 11/12.

The ovisacs are yellowish in colour and very long and extend backwards through eight or ten segments. They present a beaded appearance being strongly constricted by the septa. The hinder end is dilated in some specimens.

The spermathecal ampulla is an almost spherical sac in segment VIII. The atrium in segment VII is an ovoid sac, the basal part of which is half as wide as the upper part. The duct opens into the atrium at its ectal end.

Remarks.—The present form shows resemblances to *D. annandalei* Steph. and *D. ramnadana* Mich. in several respects but the large circular papillae in 10/11 are quite distinctive of this species.

Family MEGASCOLECIDAE.

Sub-family MEGASCOLECINAE.

Genus *Plutellus* E. Perr.

Plutellus variabilis, sp. nov.

(Plate II, figs. 16, 17.)

Tenmalai, from wet mud along with *Glyphidrilus*. 11-IX-26. A number of specimens, about a dozen sexual.

Vembayam, September, 1926. A number of sexual specimens.

Peermade, 4,000 ft. 23-XII-26. Three mature specimens.

Kumily, 2,500 ft. 26-XII-26. Five specimens, all sexual.

Kottayam. From *bunds* in paddy fields. 27-XII-26. A number of sexual specimens.

External characters.—Length 50-65 mm. Diameter 1-1.5 mm.

Number of segments 82-96.

Colour during life, pale red.

Prostomium epilobous $\frac{1}{2}$ - $\frac{2}{3}$.

Dorsal pores begin in $\frac{9}{10}$.

The setae are widely paired. In segment VIII $ab = \frac{1}{2}aa = \frac{1}{2}bc = \frac{3}{4}cd$; behind clitellum $ab = \frac{1}{4}aa = \frac{1}{2}bc = \frac{1}{2}cd$; in the middle of the body $ab = \frac{1}{3}aa = \frac{1}{2}bc = \frac{3}{4}cd$. While cd remains constant throughout, aa becomes wider behind the clitellum and bc becomes wider about the middle of the body. dd which is $\frac{1}{4}$ of the circumference in the anterior segments becomes reduced to about one-seventh of the circumference in the middle of the body. Setae are sometimes absent on segment II.

The clitellum is smooth and ring-shaped and includes segments XIV-XVII (=4). Dorsal pores and setae are visible on the clitellum. The male pores are on transversely elongated papillae (Plate II, fig. 16) in the line of setae b in the setal zone of segment XVIII. Each papilla extends beyond the lines of setae a and b and is separated from the other by a short interval. Running along the middle of each papilla is a transverse groove.

The female pores are paired, very minute, in front of the setal zone of segment XIV.

The spermathecal apertures, when present, are either one pair in the setal zone of segment VIII in the position of b , or only one (on the right

side only). Both the setae *b* are absent in this segment when both spermathecae are present; seta *b* of one side is absent when only one spermatheca is present; both setae are present in specimens in which spermathecae are not developed.

Internal anatomy.—Septa 6/7–9/10 are thickened, 10/11–12/13 moderately so.

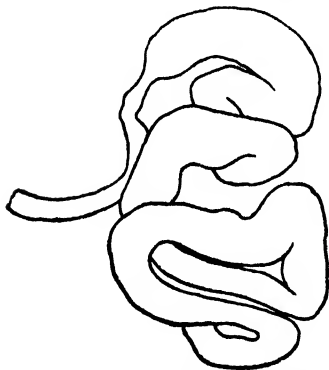
The gizzard in segment VI is rectangular in shape and slightly flattened dorso-ventrally. The intestine begins in segment XIX. There are no calciferous glands. The oesophageal swellings in segments VIII–XIV (rarely in XV and XVI also) are richly supplied with blood vessels, which are seen as numerous transverse striations.

The last heart is in XIII.

The excretory system is meganephridial, one pair per segment. The loops are not transverse but longitudinal and the nephridiopores are in the line of *b*.

The testes and funnels are free in segments X and XI. The seminal vesicles are two pairs in segments XI and XII, racemose.

The prostates are long and tubular with a few windings and occupy segments XVIII and XIX and sometimes project slightly into segment XVII. The duct is short and less than half as wide as the glandular part. It describes a bow-shaped loop with the concavity facing forwards and opens to the outside,



There are no penial setae.

The ovaries, ovarian funnels and ducts occupy the usual position in segment XIII.

The spermathecae (Plate II, fig. 17) are one pair in segment VIII or a single one (on the right side only) or absent altogether. I give below a table showing

TEXT-FIG. 21.—*Plutellus variabilis*: Prostate.

the number of specimens dissected and the conditions observed:—

| Locality. | No. of specimens dissected. | No. with one spermatheca only. | No. with one pair of spermathecae. | No. without spermathecae. |
|------------------|-----------------------------|--------------------------------|------------------------------------|---------------------------|
| Tenmalai | 11 | 2 | 3 | 6 |
| Kumily | 5 | 0 | 2 | 3 |
| Kottayam | 5 | 0 | 5 | 0 |
| Peermade | 3 | 1 | 0 | 2 |
| Vembayam | 6 | 1 | 0 | 5 |
| TOTAL . | 30 | 4 | 10 | 16 |

Of the 30 specimens dissected, 16 had no spermathecae, 4 had only one spermatheca and 10 had one pair. These results appear to indicate that the species is undergoing reduction in the number of spermathecae.

The ampulla is roughly oval. The duct, which is distinctly marked off, is about as long as the ampulla and one-third as wide as it. The single diverticulum is pear-shaped and arises from the lower end of the ampulla.

Remarks.—The present form appears to be related to *P. timidus* Cogn. recorded from Travancore. It differs, however, from Cognetti's species in several important respects such as the presence of a spermathecal diverticulum, the position of the spermathecal apertures, the presence of two pairs of seminal vesicles, and the configuration of the male field.

Genus *Pontodrilus* E. Perr.

Pontodrilus bermudensis Bedd.

Kovilam, 8 miles N. of Trivandrum. April, 1927. Six specimens. Numerous specimens of this species were collected by me from Krusadi Island, Paniben, in February 1927.

In the specimens from Kovilam the intestine begins in segment XIV; in the batch from Krusadi it begins in XV or XVI.

Nephridia begin in segment XIII. They are absent in segment XIV in the specimens from both localities.

Genus *Woodwardiella* Steph.

Woodwardiella kayankulamensis, sp. nov.

(Plate II, figs. 18, 19, 20, 21, 22.)

Kayankulam, Travancore. November, 1926. One dozen specimens, sexually mature.

External characters.—Length 65 mm. Diameter 1.1-1.5 mm. Number of segments 110-120. Colour of preserved specimen pale-yellow.

Prostomium epilobous $\frac{1}{2}$, the sides converge backwards and meet forming a V.

The dorsal pores begin in furrow $\frac{5}{7}$.

The setae are widely paired, the lateral setae very much so. In front of the clitellum $ab = \frac{1}{3}aa = \frac{1}{2}bc = \frac{1}{2}cd$; in the middle of the body $ab = \frac{3}{5}aa = \frac{1}{2}bc = \frac{1}{2}cd$. dd is slightly less than one-third of the circumference in front of the clitellum and about one-seventh of the circumference in the middle of the body.

The clitellum is smooth and ring-shaped and includes segments XIV-XVII (=4), sometimes extending anteriorly over the posterior third or half of segment XIII. Dorsal pores are present on the clitellum and setae are visible.

The male pores are on small tubercle-like papillae on segment XVIII in line with setae a . There are no copulatory papillae. The female apertures are in the setal zone of segment XIV in the interval aa .

The spermathecal pores are two pairs, in grooves $\frac{7}{8}$ and $\frac{8}{9}$, between the lines of setae a and b .

Internal anatomy.—The first septum is 5/6. Septa 5/6–8/9 are thickened, and 9/10–11/12 are moderately so.

The gizzard in segment V is short, almost rounded and not very muscular. There are no calciferous glands. The oesophagus is very vascular in segments VIII–XIII (sometimes in XIV and XV also). The intestine begins in XVII.

The last heart is in segment XIII.

The nephridia are one pair per segment throughout the body. In segments V–XXII the nephridia are 'tufts', large and bushy in V–VI, small and inconspicuous in VII–XIII, large again and flattened in XIV–XXII. From segment XXII onwards the nephridia are small but conspicuously situated with only a few loops lying longitudinally in the line of setae *b*.

The testes and funnels are free, in segments X and XI. The testes are broad, thin and plate-like, attached to the posterior face of septa 9/10 and 10/11.

The seminal vesicles are situated in segments XI and XII. They are flat and tongue-like with the margin deeply cut up.

The prostates (Plate II, fig. 19) are broad, flattened and lobulated and occupy segments XVIII–XIX. The duct is short and passes transversely inwards to open to the outside. The ectal portion of the duct is dilated.

A single penial setal sac (enclosing two penial setae) is attached to the ectal end of each prostatic duct (Plate II, fig. 20).

The penial setae are slightly bow-shaped and 270–338 μ long and 9 μ thick at the middle. The distal fifth, which projects out of the sac, is ornamented with a few very minute spines (Plate II, figs. 21, 22). The tip is sharply pointed and is often drawn out into a fine needle.

The ovaries are broad, thin and fan-like in segment XIII. There are a pair of ovisacs in segment XIV.

The spermathecae (Plate II, fig. 18) are two pairs in segments VIII and IX. The ampulla is oval and the duct, which is sharply marked off, is half as long as it. There is a single diverticulum, two-fifths as long as the ampulla and cylindrical in shape, opening into the duct a little below its ental end.

Remarks.—The nephridial condition in the present form appears to be similar to that in *Woodwardiella bahli* (23).

Genus *Megascolides* McCoy.

Megascolides chengannures, sp. nov.

(Plate II, figs. 23, 24.)

Uhengannur. 28-VIII-26. Four specimens, two sexual.

Chengannur. 14-XI-26. Twelve specimens, none sexual.

External characters.—Length 120 mm. Diameter 3 mm. Number of segments 230. The body behind the clitellum is butter coloured during life due to the large quantity of mucus present in this region. The anterior segments are pale red.

Prostomium (?).

Segments VII and VIII are biannular. Segments IX-XIII and the post clitellar segments are triannular. The first dorsal pore is in $\frac{1}{2}$.

The setae are all ventrally situated and are distinctly paired from segment XII. The setae of segments II-VII are stouter than those behind. The relative size of the setal intervals may be expressed as follows :—

In Segment VIII $ab = \frac{2}{3}aa = \frac{2}{3}bc = \frac{2}{3}cd$.

In Segment XIII $ab = \frac{2}{3}aa = \frac{2}{3}bc = cd$.

Behind the clitellum and in middle of body $ab = \frac{1}{2}aa = \frac{1}{2}bc = \frac{2}{3}cd$.

Behind the clitellum the ventral break gets wider and the setae get more closely paired.

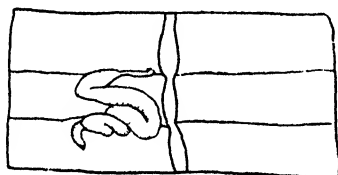
The clitellum is smooth and ring-shaped and extends over segments XIV-XVIII (=5).

On segment XVIII there is a median longitudinal depression that passes anteriorly into segment XVII and expands into a large transverse depression which extends a little beyond the setal zone. Posteriorly the median depression is confluent with a narrow transverse depression occupying the anterior third of segment XIX.

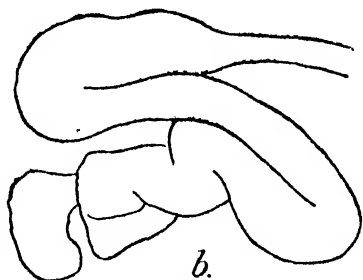
On either side of the median depression in segment XVIII is a papilla with a rounded inner border. The male pores are situated on these papillae in line with setae *a*.

The female pores are paired in a transversely oval narrow whitish area in the setal zone of segment XIV.

The spermathecal apertures are two pairs on minute tubercle-like papillae in $\frac{7}{8}$ and $\frac{8}{9}$ in line with setae *a*.



a.



b.

TEXT-FIG. 22.—*Megascolides chengannures* : Prostate. *a.*, showing position of prostate in the segment; *b.*, prostate, magnified.

Internal anatomy.—Septum 5/6 is thin; 6/7-12/13 are thickened.

The gizzard in segment V is almost spherical. There are four pairs of calciferous glands in segments X-XIII. The glands are ovoid,

flattened and lamellated internally. The intestine begins in XV. The typhlosole is present as a conspicuous median ridge.

The last heart is in segment XIII.

In the preclitellar region the nephridia are large 'tufts', one pair per segment at the sides of the oesophagus. From segment XIV onwards a large number of small micronephridia are arranged in each segment in a single transverse row close to the septum. There are no integumental nephridia in any part of the body.

Testes and funnels are free in segments X and XI. Seminal vesicles are two pairs in segments XI and XII, large and racemose.

Prostates are tubular and consist of a few adpressed coils which occupy segments XVIII and XIX. The duct is short, very thin and not shiny. It passes straight inwards to open to the outside.

The spermathecae are two pairs in segments VIII and IX. They are long, simple, club-shaped sacs. The ampulla and the duct are not marked off though the swollen distal third of the sac is twice as wide as the long tubular proximal part. There is no diverticulum.

There are no penial setae.

Remarks.—The present species, which appears to be closely related to *M. pilatus*, is distinguished from it chiefly by the absence of penial setae and integumental nephridia.

Genus *Notoscolex* Fletcher.

Notoscolex tenmalai (Mich.) var. *ghatensis*, nov.

(Plate II, figs. 25, 26.)

Tenmalai, Travancore. 9-X-1926. Seven specimens, all sexually mature.

External characters.—The largest specimen in the collection was 135 mm. long and had 315 segments.

The prostomium is proepilobous.

Dorsal pores begin in furrow $\frac{5}{6}$.

The setae are paired, *ab* more closely than *cd*. The relative size of the setal intervals may be expressed as follows:—

In front of the clitellum $ab = \frac{1}{3}aa = \frac{1}{3}bc = \frac{1}{2}cd$.

Behind the clitellum $ab = \frac{2}{3}aa = \frac{1}{2}bc = \frac{2}{3}cd$.

dd is slightly less than half the circumference in front of the clitellum and one-third of the circumference behind it.

The clitellum is smooth and ring-shaped and includes $\frac{1}{3}$ XIII-XVI (=3 $\frac{1}{3}$). Dorsal pores are absent on the clitellum.

The male field is a rectangular area extending from the setae of segment XVII to the end of segment XVIII. The area is composed of two cushions separated by a median depressed interval (Plate II, fig. 25). The outer margin of each cushion is straight and the inner border is bow-shaped, convex to the middle line. Running along each cushion, parallel to its inner border, is a narrow longitudinal groove. The male pores are situated a little to the outer side of the posterior end of the longitudinal groove, in line with setae *b*. The pores are made out by treating the body wall with a weak solution of caustic potash. Setae *a* and *b* are absent on segment XVIII.

The female pore may be single or paired, in a small transversely elongated area in the setal zone of segment XIV.

The spermathecal apertures are narrow transverse slits in $\frac{7}{8}$ and $\frac{8}{9}$ in line with setae *a*. Setae *a* of segment VIII are absent.

Internal anatomy.—Septum 5/6 is very thin; 6/7-8/9 are greatly thickened, 9/10-10/11 less so.

The gizzard is in segment V, strongly developed and rectangular. There are no calciferous glands. The oesophagus is segmentally swollen in VII-XIV and very vascular. The intestine begins in XVI.

The last heart is in XIII.

The excretory system is micronephridial. Large tufted nephridia, one pair per segment, are present in the clitellar and preclitellar segments. From segment XX onwards there are, in each segment, a small number (5-7 on each side) of micronephridia.

The testes and funnels are free in segments X and XI. The vesiculae seminales are two pairs in XI and XII, long conical bags with a wavy margin.

The prostates are long, flattened, much lobulated glands, occupying segments XVIII-XXIV (7 segments). The short duct proceeds transversely inwards and opens to the outside.

There are no penial setae.

The spermathecae (Plate II, fig. 26) are two pairs in segments VIII and IX. The ampulla is oval and hangs down from the upper end of the duct. The duct is distinctly marked off and is more than one-and-a-half times as long as the ampulla. A single club-shaped diverticulum, one-third as long as the duct, arises from it a little above its ectal end. Glandular appendages are absent.

Remarks.—The present form differs from the type form *N. tenmalai* in the setal intervals, the smaller extent of the clitellum, the position of the gizzard and the intestine, the form of the spermathecae and the absence of glandular appendages round them, and in the configuration of the male field. As the present specimens were collected from the same locality as Michaelsen's specimens, I was at first tempted to regard them as identical with the type form, but the differences enumerated above are so distinct that the present form should be ranked as a variety. I have noted that slight variations may be caused in the appearance of the male field by the degree of sexual maturity, and also by the degree of contraction of this part of the body during the process of killing. There are in my collection two individuals of this variety in which the cushions are rather oval with the inner border of each straight (instead of bow-shaped) and the depressed interval between the cushions wider.

***Notoscolex tenmalai* var. *karakulamensis* Steph.**

Trivandrum. August, 1926. Numerous specimens.

A few notes may be added to supplement Stephenson's account (17). Number of segments 148.†

Prostomium prolobous.

Dorsal pores begin in $\frac{4}{5}$.

The female pore is single on a small oval patch in the setal zone of segment XIV.

Internal anatomy.—The oesophagus is very vascular in segments XI-XIV.

There are a pair of ovisacs in segment XIV.

In one specimen an abnormality was noted. The oval elevation was repeated on segment XIX on the left side. The specimen was dissected and it was seen that there were two fully developed prostates on this side each having its own duct, the anterior duct opening on segment XVIII and the posterior on segment XIX.

***Notoscolex peermadensis*, sp. nov.**

(Plate III, figs. 27, 28, 29.)

Peermade, Travancore, 3,500 ft. 23-XII-1926. From edge of river amongst roots of grass. Numerous specimens, sexual.

External characters.—Length 75 mm. Diameter 2 mm. Number of segments 164.

Prostomium epilobous $\frac{1}{2}$, tongue either open behind or closed by a cross furrow.

Dorsal pores begin in furrow $\frac{5}{8}$.

Setae eight throughout the body; *ab* paired and *cd* very widely so. Both behind and in front of the clitellum $ab = \frac{1}{2}aa = \frac{1}{2}bc = \frac{1}{2}cd$ and *dd* is slightly greater than $\frac{1}{3}$ of the circumference.

The clitellum is smooth, ring-shaped and extends over segments XIV— $\frac{1}{2}$ XVII ($=3\frac{1}{2}$). Dorsal pores are present on the clitellum and setae are slightly visible.

The male field is a thickened, rectangular area, with more or less rounded sides, occupying the narrow posterior half of segment XVII, segment XVIII, and a portion of the anterior half of segment XIX. Laterally the area extends to the line of setae *b*. The middle portion of this field is slightly depressed longitudinally.

The male pores are on segment XVIII in line with setae *a*.

The female aperture is single, in the setal zone of segment XIV, in the centre of a small oval area in the middle of *aa*.

The spermathecal pores are two pairs in $\frac{7}{8}$ and $\frac{9}{10}$ in line with setae *b*.

Internal anatomy.—Septum 5/6 is thin, 6/7 to 9/10 are thickened and 10/11 to 11/12 are moderately so.

There is a well developed gizzard in segment V. The intestine begins in XV, XVI, or XVII. There are no calciferous glands.

The last heart is in segment XIII.

The excretory system is micronephridial. Bushy nephridial tufts, one pair per segment, are present in the preclitellar and clitellar segments. In the post-clitellar region four or five small micronephridia are present on each side per segment.

Testes and funnels are free in segments X and XI. Seminal vesicles are two pairs in segments XI and XII, flattened and lobulated, those in segment XI are rather small in some specimens.

The prostates are thick and loosely lobed and extend through three or four segments. The shiny duct makes one or two curves and then proceeds obliquely backwards and inwards to open to the outside. The duct is narrow entally and gets wide towards the ectal end.

A single setal sac containing two penial setae opens to the outside in close connection with each prostatic duct. The penial setae are 1 mm. in length and $9-10\mu$ in thickness. At the end of the proximal half the shaft gets wavy. The distal portion of the shaft is ornamented with two rows of minute spines occurring at relatively long intervals. The tip is pointed (Plate III, fig. 29).

The ovaries occupy the usual position in segment XIII. There are a pair of small ovisacs in segment XIV.

The spermathecae are two pairs in segments VIII and IX. The ampulla is club-shaped, narrowing to form the duct, which is not marked off. A single pear-shaped diverticulum arises from about the middle of the duct (Plate III, fig. 28).



TEXT-FIG. 23.—*Notoscolex peermadensis*: penial setae, general form, $\times 155$.

Remarks.—The present species is related to *N. gravelyni* Steph. but is distinguished from it by its large size, the single median female pore, the position of the gizzard and the intestine, absence of meganephridia and the presence of ornamentation on the penial setae.

***Notoscolex travancorensis*, sp. nov.**

(Plate III, figs. 30, 31.)

Peermade, Travancore, 4000 ft. 23-XII-26. Four sexual specimens and a few immature ones.

External characters.—Length 100-110 mm. Diameter 2 mm. anteriorly and 1.5 mm. posteriorly. Number of segments 200-210. Colour pale yellowish-grey, clitellum yellow.

Prostomium is proepilobous. There is a longitudinal mid-dorsal furrow on the anterior half of segment I.

The first dorsal pore in furrow $\frac{1}{4}$. The setae are paired, cd widely. Behind the clitellum $ab - \frac{1}{2}aa = \frac{1}{2}bc = \frac{1}{2}cd$, and dd is slightly greater than one-third of the circumference. In the middle of the body the relative sizes of the setal intervals are the same but dd is only one-fifth of the circumference. At the hinder end $ab - \frac{4}{5}aa = \frac{1}{5}bc = \frac{4}{5}cd = \frac{1}{5}d$.

The clitellum is thick, smooth and ring-shaped and includes $\frac{1}{3}$ XIII—XVII ($=4\frac{1}{3}$). Dorsal pores are absent and setae are seen only very indistinctly.

On the ventral side of segment XVIII are a pair of circular papillae with a broad whitish thickened border. Each papilla takes up the whole length of the segment and extends inwards to the line of setae a or slightly beyond and outwards to about two-thirds bc . Occupying the middle of each papilla is a bean-shaped elevation with the hilus turned away from the middle line. The male pores are situated in the bean-shaped elevation in line with setae b .

The female pores are paired, in the setal zone of segment XIV, in a transversely elongated whitish area which extends from a to a .

The spermathecal apertures are two pairs in $\frac{7}{8}$ and $\frac{8}{9}$ in line with the setae *b*.

Internal anatomy.—Septum 5/6 is very thin ; 6/7-9/10 are much thickened ; 10/11-11/12 moderately so.

The gizzard is in segment V. It is flattened dorso-ventrally and the sides are rounded. There are no calciferous glands. The oesophagus is segmentally swollen and is very vascular in segments XI-XIII. The intestine begins in segment XVI.

The last hearts are in segment XIII.

The excretory system is micronephridial. Large bushy nephridial tufts, one pair per segment, are present in the preclitellar and clitellar regions. In the clitellar segments the tufts look expanded as the loops are long and loose. In the post-clitellar segments four or five small nephridia occur on each side.

The worm is metandric. Testes and funnels are only one pair in segment XI, enclosed in a thin testis sac which curves round the oesophagus on each side.

The seminal vesicles are one pair in segment XII. They are long, and narrowing towards the tip are attached to the septum by a broad base.

The prostates are long, narrow, and loosely lobed, and extend through about two segments ; their outer edges meet above the gut in the mid-dorsal line. The thin proximal half of the duct describes two or three small loops. The duct then becomes wider, describes a large loop, convex in the middle line, and opens to the outside.

The ovaries are in segment XIII. A pair of small ovisacs are present in segment XIV.

The spermathecae (Plate III, fig. 31) are two pairs in segments VIII and IX. The ampulla is thin-walled, long and club shaped, the lower narrowed portion being only one-third as wide as the swollen distal part. The duct is very short and is practically embedded in the body wall. A single pear-shaped diverticulum with a simple chamber arises from the ectal end of the ampulla close to the body wall.

There are no penial setae.

***Notoscolex minimus*, sp. nov.**

(Plate III, figs. 32, 33 ; Plate IV, fig. 44.)

Peermade, 4,000 ft. 22-XII-26. One dozen specimens, mostly sexual.

External characters.—Length 37-45 mm. Diameter 1.5 mm. in the anterior part of the body and 1 mm. in the middle and hinder regions. Number of segments 104-124.

Prostomium broad and epilobous $\frac{1}{2}$ - $\frac{3}{4}$. Sides parallel and tongue open behind.

The first dorsal pore is in furrow $\frac{5}{6}$.

The setae are paired, the ventral setae rather closely and the lateral setae very widely throughout the body. In segment XII $ab = \frac{1}{2}ca = \frac{2}{3}bc = \frac{1}{4}d$; and dd is two-seventh of the circumference. Behind the clitellum $ab = \frac{1}{3}aa = \frac{1}{3}bc = \frac{1}{4}cd$ and dd is about $\frac{1}{8}$ of the circumference. Posteriorly $ab = \frac{2}{3}aa = \frac{2}{3}bc = \frac{1}{4}cd$ and dd gets considerably reduced and is slightly less than the ventral break. In the post-clitellar region the intervals *aa*, *bc*, and *cd* remain fairly constant but *ab* gets wider and

dd narrower. In the last ten segments the arrangement of the setae is slightly irregular.

The clitellum is ring-shaped and includes segments XIV—XVII (—4), but ventrally it sometimes extends over the posterior half of segment XIII.

On the ventral side of segment XVIII are two small circular papillae each taking up the interval between the lines of setae *a* and *b* and nearly the whole length of the segment. The male pores are on these papillae between the lines of setae *a* and *b*, much nearer to *b* than *a*. In three specimens in the collection there was a glandular thickening in the interval *aa* on the posterior half of segment XVII and a similar thickening was present on the anterior half of segment XIX.

The female pore is single and median in the centre of a small transversely elongated area in the setal zone of segment XIV.

The spermathecal apertures are two pairs in $\frac{2}{3}$ and $\frac{8}{9}$ in line with setae *b*.

Internal anatomy.—Septum 5, 6 is very thin; 6/7–8/9 are thin; 9/10–11/12 are slightly thickened.

The gizzard is in segment V and is cylindrical. There are no calciferous glands. The oesophagus is vascular in segments XII–XIV. The intestine begins in segment XVI.

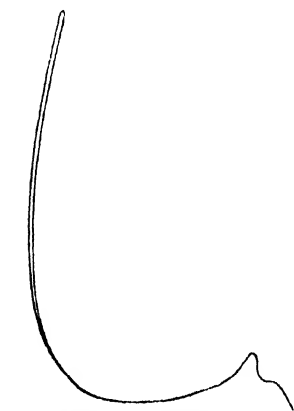
The last heart is in segment XIII.

One pair of tufted nephridia per segment are present in the anterior segments in front of the clitellum the pairs at the level of the anterior and posterior ends of the gizzard being conspicuously large. In the clitellar region there are two or three expanded tufts on each side per segment. Each segment behind the clitellum has four or five small flattened nephridia on each side.

The testes and funnels are free, in segment X and XI. The seminal vesicles are in segments IX and XII; those in segment IX are attached to the anterior face of septum 9/10.

The prostate is flattened and lobed and has branching canals. It occupies segments XVIII and XIX and sometimes extends into segment XX. The duct runs transversely inwards, then forwards, describing a broad loop; it then proceeds backwards forming a second loop. The distal half of the duct is wide, shiny and S-shaped (Plate III, fig. 32).

A penial setal sac with two setae is present on each side. The sacs are attached to the body wall dorsally by strong muscle bands. Each penial seta is bent in the form of a bow and is 1.1 mm. long, 11 μ thick proximally, and 5 μ thick at the distal end just before its emergence from the body wall. The seta describes one spiral twist when passing through the body wall and the exposed distal end, which is 63 μ in length, is



TEXT-FIG. 24.—*Notoscolex mini-mus*: penial seta, general form, \times about 170.

straight and tapering and is ornamented with a double series of closely-set finely pointed spines. When this distal portion (Plate III, fig. 33a, b) is examined as the seta lies on one side, only one row of serrations is seen and it presents an appearance like the sting of the honey bee.

The spermathecae (Plate IV, fig. 44) are two pairs in segments VIII and IX. The ampulla is ovoid. The duct is marked off and is about one-third as long as the ampulla. A single cylindrical diverticulum, half as long as the ampulla, arises from the upper end of the duct at its junction with the ampulla.

Genus *Megascolex* Templeton.

Megascolex travancorensis (Mich). var. *proboscidea*, nov.

(Plate III, figs. 34, 35, 36).

Tenmalai, 1,000 ft. From a hill slope by the side of a road. 14-IX-26 and 19-X-26.
Numerous specimens.

External characters.—Length 105-180 mm. Diameter 2 mm. Number of segments 192-213. Colour pale white, no pigmentation. The prostomium is proepilobous and is an almost conical lobe overhanging the mouth.

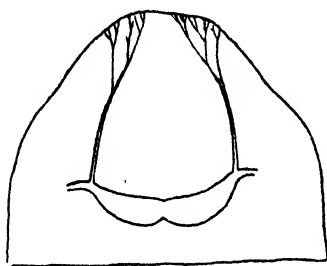
Proboscis.—In addition to the prostomium this species possesses a proboscis-like organ comparable to the proboscis of certain groups of worms. The protrusion and retraction of this interesting organ which functions as a feeler in living specimens may be watched. When fully protruded the proboscis measures 4 mm. in length. From dissections and sections (Plate III, fig. 36) it is clearly seen that it arises from the dorsal wall of the buccal cavity from a pocket like invagination in front of the brain. When the worms are killed in strong spirit the proboscis is retracted and is seen only as a straight knob projecting from the buccal cavity beneath the contracted prostomium and is, therefore, easily overlooked. Many of my specimens were first narcotised in very weak spirit and then transferred to 10 per cent. formalin for 6 hours. I was thus able to preserve the proboscis in a fairly protruded condition. In specimens in which the anterior portion of the buccal cavity gets everted in the process of killing, the proboscis pocket also gets completely everted and the proboscis comes to lie in front of the prostomium and appears to be an extension of it though really it is not.

The proboscis is long and cylindrical (.024 mm. thick at the distal end and .018 mm. thick at the base), sometimes club-shaped with a swollen distal portion. It has a segmented appearance due to four or five ring-like constrictions round it. Beneath the epidermis is a layer of circular muscle fibres surrounding a stout axial core of longitudinal fibres. These latter are retractor in function and are attached behind to the dorsal wall of the buccal cavity above the brain.

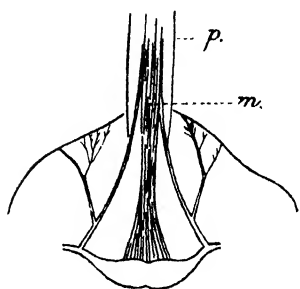
There are, as usual, two cerebral nerves, one on each side. Each of these soon divides into two branches. The outer branch supplies the prostomium. The inner, which is stouter, passes into the proboscis

along with its fellow. In *Megascolex mauritii*, in which a proboscis

is absent, the two branches of each cerebral nerve are of equal thickness and both supply the prostomium.



a.



b.

TEXT FIG. 25.—a., *Megascolex mauritii*: Brain and cerebral nerves. b., *Megascolex travancorensis* var. *proboscidea*: Brain and cerebral nerves.

Beddard in his monograph mentions two species of earthworms possessing a structure apparently similar to the one described above though he calls it 'prostomium' in both cases. With regard to one of them, viz., *Trichochaeta hesperidum*, he says that "it protrudes from the mouth, and in sections is seen to arise from a slight invagination of the dorsal wall of the buccal cavity just in front of the brain"—a condition almost exactly similar to that obtaining in my worms. The presence in *Oligochaeta* of a tactile organ distinct from the prostomium is of great interest.

The first dorsal pore is in furrow $\frac{5}{8}$. In a few specimens an indistinct pore was noticed in $\frac{4}{8}$.

The setae are in rings. The dorsal break, which is wide anteriorly, gets reduced in the posterior region till it is about three-fourths of the ventral break. The setae are not paired in the anterior segments. The following numbers were

counted:—12/II-III, 16/IV-VIII, 20/IX-XIII, 22/XIX, 24/XXV, 24/hinder end.

The clitellum is ring-shaped and extends over $\frac{1}{2}$ XIII-- $\frac{1}{2}$ XVII (=4).

The male field is a heart-shaped cushion (Plate III, fig. 34) with the broad base anterior, a little behind the setal zone of segment XVII and the rounded narrow apex posterior, at the level of the setae of segment XIX or slightly behind it. The cushion has a median depression beginning from the setal zone of segment XVIII and extending backwards to about the end of the anterior quarter of segment XIX. The male pores are minute apertures in the setal zone of segment XVIII in line with setae b. Setae a, b, c, d are absent on XVIII, while in segment XIX, a, b, and c are carried slightly backwards by the posterior border of the cushion.

The female pores are paired on a small transversely elongated area in the setal zone of segment XIV.

The spermathecal apertures are minute pores in $\frac{7}{8}$ and $\frac{8}{8}$ in line with setae a.

There is a longitudinal dumb-bell shaped depression occupying segments VIII-IX (Plate III, fig. 35). The depression, which begins a little in front of furrow $\frac{1}{4}$, extends backwards to the setal zone of IX and is bordered all round by a thickened rim.

Internal anatomy.—Septum 5/6 is very thin and membranous ; 6/7-8/9 are thickened. 9/10-12/13 moderately so.

The gizzard is in segment V. There are no calciferous glands. The intestine begins in XVI.

The last heart is in segment XIII.

The excretory system is micronephridial. In the preclitellar segments there are one pair of large tufted nephridia per segment : in the clitellar and post-clitellar regions there are a number of small micronephridia per segment attached to the parietes on each side. The parietal nephridia in the clitellar segments are fewer in number and larger than those of the segments behind.

The testes and funnels are free in segments X and XI. The seminal vesicles are long conical sacs in segments XI and XII.

The prostates are long, flat and much lobulated and extend through about nine segments. The thin ectal end of the duct describes a small semicircular loop, the concavity facing forwards. At the end of this loop the duct gets wide, muscular and shiny and proceeds straight backwards to open to the outside. Just before its termination the duct becomes thin and describes a second small loop similar to the first.

The spermathecae are two pairs in segments VIII and IX. The ampulla is a thin-walled pear-shaped sac, narrow in its ectal portion. The duct is short and is not marked off from the narrow ectal part of the ampulla. A club-shaped diverticulum, about half as long as the ampulla, arises from its ectal end. It was noticed that in immature specimens the diverticulum is longer than the ampulla.

There are no penial setae.

Remarks.—The present form is doubtless a variety of the species *M. travancoricnsis* but differs slightly from the four known varieties of the type-form. The male field approaches very nearly to that of the variety *ghatensis*. The present form differs, however, from that variety in the shorter spermathecal diverticulum, the position of the gizzard, the copulatory cushion in the spermathecal region, and the presence of a retractile proboscis. At the same time, I am conscious of the possibility of the present form turning out to be identical with *ghatensis*. The slight difference in the male field in the case of Michaelsen's specimens may be due to their bad preservation and he might possibly have overlooked the proboscis, which is completely retracted in specimens killed without first being narcotised.

***Megascolex auriculata*, sp. nov.**

(Plate III, figs. 37, 38).

Vandiperiyar, 2000 ft. Edge of a canal. 24-XII-26. A number of specimens, all sexual.

Kumili, 1,500 ft. Edge of submerged rice-field. 26-XII-26. Numerous specimens.

External characters.—Length 85-115 mm. Diameter 2 mm. Number of segments 184-214. The body is dull grey in colour and the clitellum is yolk-yellow.

The prostomium is proepilobous.

The dorsal pores begin in furrow T_0^9 .

The setal arrangement is purely lumbricine till the middle of the body, *ab* closely paired and *cd* widely so. The tendency to change to the perichaetine condition is seen to begin here. While the interval *ab* continues to be regular, either the seta *c* or *d* or both often get moved a little inward or outward from their usual position and an extra seta or two are sometimes developed. From about segment CXXV (in a specimen with 214 segments) the usual number of setae per segment is found to be 10, though 8 and very rarely 12 also occur. Towards the extreme hinder end 12 setae become the rule though even here some segments have only 10. The intersetal relations in a few segments are shown in the table below :—

Segment X.

$aa : ab : bc : cd : : 10 : 4 : 9 : 8.$

Segment XIX.

$aa : ab : bc : cd : : 4 : 2 : 5 : 3.$

Segment XXXVI.

$aa : ab : bc : cd : : 6 : 2 : 5 : 4.$

dd in all these is slightly less than half the circumference.

The clitellum is yolk-yellow in colour, thick and ring-shaped, and extends over segments XIV- $\frac{1}{2}$ XVII (= 3 $\frac{1}{2}$). In a few specimens the clitellum includes the posterior half of segment XIII also.

On the ventral surface of segment XVIII are two excavations placed obliquely (diverging anteriorly), separated by an interval equal to *aa*. Each excavation is bounded, except on its inner side, by a broad, much thickened, glandular lip. The pit-like depression with the broad lip along three sides of it resembles an ear with the opening of the meatus. In two specimens the excavations have fused to form a single rectangular depression. The male pores are on segment XVIII in line with setae *b*.

The female pores are paired, in the setal zone of segment XIV in the interval *aa*. The pores are separated by $\frac{1}{3}$ *aa*.

The spermathecal apertures are two pairs in $\frac{7}{8}$ and $\frac{8}{9}$ in line with the setae *b*.

Internal anatomy.—Septa 6/7-9/10 are very thick, 10/11 is slightly thickened and the next two septa very slightly so. There is a strongly developed, barrel-shaped gizzard in segment VI. There are no calciferous glands. The oesophageal swellings in segments VII-XIV are very vascular and the internal surface is thrown into villi. The intestine begins in segment XVI. In segments XVIII-XXI, being pressed upon by the large prostates, it becomes narrower.

The last heart is in segment XIII.

Tufted nephridia, one pair per segment, are present in the anterior segments. In the clitellar region the tufts are flattened and plate-like, and composed of a number of long winding tubes. In the post-clitellar region there are, in each segment, 5 or 6 small tufts on each side, attached to the posterior face of the septum.

Testes and funnels are only a single pair in segment XI, enclosed in a large unpaired testis sac attached to the posterior face of septum 10/11. The sac is narrow in the mid-ventral line below the oesophagus.

The seminal vesicles are a single pair in segment XII. They are grape-like and long but confined to segment XII.

The prostates are thick and loosely lobed and extend through three or four segments. The duct, which arises from the anterior part of the gland after a few windings, proceeds straight backwards to open to the outside. The ectal half of the duct is twice as wide as the ental portion and very shiny.

There are no penial setae.

Ovaries and funnels are in segment XIII.

The spermathecae are two pairs in segments VIII and IX. The ampulla is long and thickly club-shaped, the basal portion being more than half as wide as the distal half. The duct is very short. A single diverticulum, almost cylindrical in shape,

arises from the base of the ampulla.

Remarks.—The present species appears to form the nearest link to *Notoscolex*. The two other species forming a transition from *Notoscolex* to *Megascolex* are *M. willeyi* Mich and *M. zygochaetus* Mich.

***Megascolex avicula*, sp. nov.**

(Plate III, figs. 39, 40, 41, 42.)

Peermade, 4,000 ft. 23-XII-26. A number of specimens, sexually mature.

External characters.—The length of the specimens varies between 50 and 70 mm. Diameter 2 mm. Number of segments 120-154. Colour pale slaty grey, clitellum yellow.

The prostomium is prolobous.

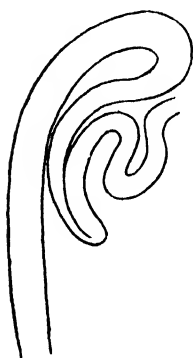
The first dorsal pore is in $\frac{2}{3}$.

The setae are lumbricine in the clitellar and preclitellar regions, *ab* more closely paired than *cd*. In segment IX $ab = \frac{3}{8}aa = \frac{3}{8}bc = \frac{1}{2}cd$; and *dd* is half the circumference. The numbers counted are:—8/II-XIX, 12/XX-L, 14/L-LX, 16/LXI, and 25-30/hinder end. The setae are paired up to the middle of the body. In the post-clitellar region *aa* remains nearly constant while *zz* gets gradually reduced posteriorly. In segment XXXVI *zz* is $2ac$, in segment LIX it is $1\frac{1}{2}aa$ and in segment XC it is $\frac{3}{4}aa$.

Segments I-V are narrow. The remaining preclitellar segments are broad and triannular.

The clitellum is thick and saddle-shaped and extends over segments $\frac{2}{3}$ XIII-XVII ($-4\frac{2}{3}$). As the middle ventral region is free from clitellar epidermis the grooves and setae are visible. The grooves are completely obliterated on the dorsal and lateral sides. Dorsal pores are present.

Occupying the whole of the ventral side of segment XVIII is a transverse depression slightly narrowed in the middle and surrounded by a thickened ridge. Situated in the depression on either side of the middle



TEXT-FIG. 26.—*Megascolex auriculata*:
Prostatic duct.

line is a transversely elongated elevation with a rounded inner end. The male pores are on the inner ends of these elevations almost in line with setae *a*.

The female pores are paired in front of the setal-zone of segment XIV in line with setae *a* or a little internal to it.

The spermathecal pores are two pairs in $\frac{7}{8}$ and $\frac{8}{9}$ internal to the line of *a*.

Internal anatomy.—Septum 5/6 is thin, 6/7-9/10 are thickened and 10/11-11/12 moderately so.

There is a strongly developed cylindrical gizzard in segment V. There are no calciferous glands. The oesophagus is very vascular in segments XII-XIV and lamellated internally. The narrow oesophagus suddenly dilates in segment XVII to form the intestine.

The last heart is in segment XIII.

The excretory system is meganephridial (?). A pair of large tufted nephridia are present in segment V. Each of these has a stout duct which opens to the outside through the body wall. In the following preclitellar segments and in the clitellar region there are one pair of tufted nephridia per segment. Behind the clitellum, there are, in each segment, one pair of small flattened nephridia, apparently of the nature of meganephridia. In one of these I made out seven loops, a few of which are transverse, a few lie longitudinally and others obliquely.

The testes and funnels are free in segments X and XI. There is a hardened mass of free spermatozoa in these two segments.

The vesiculae seminales are two pairs in segments IX and XII. The anterior pair are flattened and attached to the anterior face of septum 9/10. The posterior pair are long and racemose and occupy the usual position in XII.

The prostates are thick and loosely lobed and extend through four or five segments. The duct is stout and shiny and runs obliquely forwards and inwards to open to the outside. The distal portion of the duct is wide.

The ovaries occupy the usual position in segment XIII. A pair of small ovisacs are present in segment XIV.

The spermathecae are two pairs in segments VIII and IX. The ampulla is ovoid and thin-walled and a single pear-shaped diverticulum arises from its lower end. The diverticulum is one third as long as the ampulla and is filled with masses of ripe spermatozoa. The duct is one-third as long as the ampulla and one fourth its width.

The penial setae are 1.1 mm. long and very narrow, being only 5μ thick proximally. The distal portion of the seta is ornamented with long narrow pointed spines arranged in pairs at intervals. The ornamentation does not extend up to the tip. The tip of the seta is slightly recurved (Plate III, figs. 41, 42).

Muscle strands attach the penial setal sac of each side to the lateral body wall of segment XXI.

Remarks.—The condition of the nephridia is similar to that in *Woodwardiella kayank lamensis* described in this paper. If the tufted nephridia are really meganephridia then the condition in the present form is meganephridial throughout.

Megascolex ratus Cogn.

(Plate IV, fig. 43.)

Bonaccord. September, 1923. One specimen.

Mukkunni Reserve Forest. August, 1924. One specimen, sexual.

Trivandrum. August, 1926. Four specimens, two sexual.

Trivandrum. November, 1926. Three specimens, one sexual.

The species has been fully described by Cognetti (6) and his account has been supplemented by Stephenson (17). A few notes on certain features of the present specimens may, however, be added.

The dorsal pores begin in $\frac{6}{7}$. Paired papillae on $\frac{1}{7}$, $\frac{1}{2}$ and $\frac{2}{3}$ are present in all the specimens; papillae on $\frac{1}{6}$ and $\frac{2}{5}$ are present in three specimens only; papillae on $\frac{2}{3}$ are present in one only. In the specimen whose clitellar region is figured (Plate IV, fig. 43) only one papilla is present on $\frac{2}{3}$.

Internal anatomy.—Septum 5/6 is thin and membranous. The gizzard is in segment V. There are no calciferous glands. The oesophagus gives off four pairs of vascular caeca in segments XI-XIV, those in segment XI being the smallest. Each sac opens into the oesophagus by a wide opening. The outer surface of the sacs is smooth and the inner surface is strongly lamellated. The oesophageal wall between two successive caeca projects into the lumen as a ridge on which are a few conspicuous vertical lamellae.

One pair of large tufted nephridia are present in segment III by the side of the pharynx, one pair in segment IV by the side of the narrow oesophageal part, and one pair in segment V by the side of the gizzard. Tufted nephridia were not noticed in any other of the anterior segments. Large numbers of minute micronephridia are attached to the parietes from segment IV backwards. In the clitellar region the integumental nephridia are larger and more numerous.

Megascolex trivandranus Steph.

Trivandrum. 20-VII-1926. Numerous specimens.

Chengannur. October, 1926. A number of specimens.

The female apertures are paired.

A pair of small ovisacs are present in XIV.

Megascolex peermadensis, sp. nov.

(Plate IV, figs. 45, 46.)

Peermade, 4000 ft. 24-XII-26. Five specimens, two sexual.

External characters.—Length of specimens 50-76 mm. Diameter 1.5 mm. Number of segments 157.

Prostomium epilobous $\frac{1}{3}$, tongue very narrow and open behind.The first dorsal pore is in $\frac{5}{8}$ (?).

The setae are in rings. The dorsal break is wide anteriorly and gets gradually reduced behind the clitellum, as the setae increase in number. In segment X $zz=7yz$; behind the clitellum $zz=3-3\frac{1}{2}yz$. The following are the numbers counted:—12/V, 12/XII, 18/XIX, 18/XXXVI, 24/C.

The clitellum is ring-shaped and extends over segments XIV-XVII (-4). Dorsal pores are present.

The male field, which takes up the whole of segments XVIII and XIX, consists of two circular papillae with a broad transverse lip in front. The papillae nearly touch each other in the middle line and extend anteriorly up to the setal zone of segment XVIII and posteriorly as far as groove $\frac{1}{2}a$. The thickened transverse lip in front pushes forward the hinder end of segment XVII. The male pores are situated in the setal zone of segment XVIII in the position of seta *b*.

The female pore is in the setal zone of segment XIV in the centre of *aa*.

The spermathecal apertures are two pairs in $\frac{7}{8}$ and $\frac{8}{9}$ in line with setae *b*.

Internal anatomy.—The septum 5/6 is very thin, 6/7-9/10 are thickened, 10/11 and 11/12 are moderately so.

The gizzard is strongly developed, long and cylindrical, in segment V. There are no calciferous glands. The intestine begins in XVI.

The last heart is in XIII.

The excretory system is micronephridial. Tufted nephridia, one pair per segment, are present in the anterior segments. The tufts by the side of the gizzard are large and bushy. Those in VI to XIII are close to the septa on their anterior face and are almost adherent to them. In the clitellar segments the tufts occur on the parietes and are much enlarged. From segment XIX onwards there are four or five small nephridia on each side, attached to the parietes in a single transverse row.

The testes and funnels are one pair, free, in segment XI (metandric). A hardened sheet-like mass of free spermatozoa is present in this segment.

The vesiculæ seminales are long and racemose, one pair, in segment XII.

The prostate is long and deeply cut up into lobes and extends through about ten segments. The duct runs transversely outwards, then bending inwards forming a loop proceeds transversely inwards parallel and close to the proximal half, and opens to the outside. The distal half of the duct is stout and shiny.

The ovaries are in segment XIII. A pair of ovisacs are present in segment XIV.

The spermathecae are two pairs in segments VIII and IX. The ampulla is long and pear-shaped, gradually narrowing towards the duct. The duct is very short and is not marked off from the ampulla. A single cylindrical diverticulum about half as long as the ampulla arises from its lower end at its junction with the duct (Plate IV, fig. 46).

There are no perianal setae.

Megascolex kumiliensis, sp. nov.

(Plate IV, figs. 47, 48, 49, 50.)

Kumili, Travancore. 1500 ft. A number of fully mature specimens.

External characters.—Length 100-120 mm. Diameter 3 mm. Number of segments 212. The post clitellar segments are narrow and triannular.

Prostomium epilobous, tongue narrowed behind. Dorsal pores begin in furrow $\frac{10}{11}$.

The setae are in rings. The ventral break is regular and setae *a* and *b* are paired throughout the body, widely in the most anterior segments, and rather closely from the twelfth segment backwards. The following numbers were counted :—8/II, 12/III—XVII, 8/XVIII, 16/XIX—CXCXV, 24/hinder end.

The clitellum is thick and ring-shaped and extends over segments XIII-XVIII (= 6). It occupies nearly the whole of segment XIII on the dorsal side but only the posterior two-thirds of the segment on the ventral side. Intersegmental furrows are obliterated on the dorsal side but are visible ventrally. Dorsal pores are present.

The male pores are on two oval papillae on segment XVIII, in line with seta *a*. Setae *a* and *b* are absent on this segment.

The female pores are paired, minute, in front of the setal zone of segment XIV, each pore being a little internal to the line of setae *a*.

The spermathecal apertures are two pairs, on segments VIII and IX in the setal zone, very close to the setae *a* on their inner side (Plate IV, fig. 48).

Copulatory cushions (Plate IV, fig. 47).—There is a rectangular transverse cushion with rounded corners on the anterior half of segment XVII. The whitish rim of the cushion is thick and raised. Anteriorly the cushion extends up to furrow $\frac{1}{7}$, pushing the furrow forwards a little, while posteriorly it reaches near to the setal zone and laterally a little beyond the line of setae *b* on each side. Occupying the anterior half of segment XX is a similar cushion of the same size. Anteriorly it encroaches slightly on segment XIX, while posteriorly it extends quite up to the setal zone and laterally to the same extent as the anterior cushion.

Internal anatomy.—Septum 5/6 is thin. Septa 6/7-9/10 are thickened and 10/11-11/12 are moderately so. There is a well developed gizzard in segment V. The intestine begins in segment XVI. There are no calciferous glands.

The last heart is in segment XIII.

In the preclitellar region there are one pair of large tufted nephridia in each segment. In the clitellar region there are four or five similar (but smaller in size) nephridial tufts on each side. From segment XXI onwards, in addition to these small nephridial tufts, there is a meganephridium on each side.

Testes and sperm funnels, one pair, free, in segment XI. The seminal vesicles are one pair, long and racemose, attached to the posterior face of septum 11/12.

The small prostates occupy segment XVIII only or segment XVIII and a part of XIX. The glandular part is flattened with the margin cut up into lobes. The duct may be divided into three distinct parts—the narrow proximal part running backwards, the wide middle part which runs forwards and the short ectal part which runs backwards, inwards and downwards, gradually narrowing to the ectal end (Plate IV, fig. 50).

There are no penial setae.

The ovaries are broad, flat, and fan-like, in segment XIII.

The spermathecae are two pairs in segments VIII and IX; the ampulla is ovoid and passes without break into the duct which is nearly half as long as it. From the lower end of the anterior third of the duct arise two diverticula, opposite to each other, slightly club-shaped, almost cylindrical (Plate IV, fig. 49).

Remarks.—The present form is very closely related to *M. sylvicola* Mich., *M. sylvicola* var. *marianae* Steph. (21) and *M. vilpattiensis* Mich. The chief differences are the presence in this form of two copulatory cushions, one on segment XVII and the other on segment XX, and the position of the spermathecal apertures in the setal zone of segments VIII and IX. The latter feature is interesting since it appears that in no other species of *Megascolex*, so far known, do the spermathecae open in the setal zone.

***Megascolex polytheca* Steph. var. *uniquus*, nov (?).**

(Plate IV, figs. 51, 52, 53, 54, 55.)

Kumili, 1500 ft. 26-XII-26. A single specimen.

External characters.—Length 135 mm. Diameter of body 3 mm. Number of segments 100 plus a regenerating hind part consisting of a little over 100 segments. Segments V and VI are biannular and VII-XIII are triannular.

The prostomium is epilobous more than $\frac{3}{2}$, tongue with parallel sides, open behind.

Dorsal pores begin in $\frac{2}{3}$.

The setae are in rings and closely set. The dorsal interval diminishes backwards while the ventral break increases. In segment IX $zz = 2yz$, in segment XL $zz = 1\frac{1}{2}yz$ and further backwards it is only yz . In segment IX $aa = 3ab$; in segment XL $aa = 4ab$. The following numbers were counted :—74/IX, 60/XIX, 52/XL.

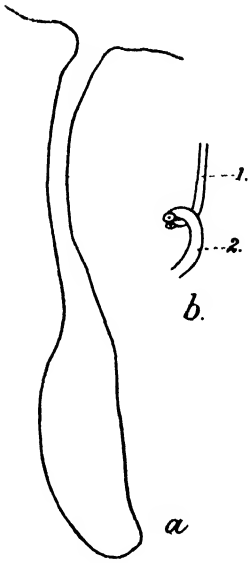
The clitellum is smooth and ring-shaped and extends over segments XIV-XVII (4).

The male pores are on segment XVIII in line with b in two depressions, each bordered on the outer side by a longitudinal thickening extending over the whole length of the segment.

The female apertures were not distinguished.

Internal anatomy.—Septum 5/6 is thin, 6/7-11/12 are much thickened. The gizzard is in segment V. There are no calciferous glands. The intestine begins in segment XIX.

The thin-walled oesophagus, on passing into segment IX, increases in thickness on the ventral side by the development of a cellular mass between the columnar epithelium lining the lumen and the peritoneal layer. The columnar epithelial cells are seen to be much elongated and their lower ends pass freely into the cell mass. The thickening is at first most conspicuous in the middle of the ventral wall which consequently projects into the lumen as a conical mass (Plate V, fig. 57). Passing onwards it is noticed that the thickening increases on either side of this central projecting mass, so that the latter becomes less and less conspicuous, till at last the whole of the ventral side gets enormously thickened. The development of the cellular tissue is, however, not confined to the ventral side but extends to the dorsal half of the oesophageal wall which consequently gets slightly thickened. The cell boundaries in this mass are difficult to make out. The cytoplasm appears to be finely granulated and the nuclei are conspicuous. The two blood vessels seen below the gut in the dissection are found to communicate with a number of parallel blood sinuses running up the thickened ventral wall and dividing the cell mass into a number of thin cell plates. These blood sinuses are in communication with similar but shorter sinuses in the dorsal half of the oesophageal wall and through these with the dorsal vessel.



TEXT-FIG. 27.—*Malabarica biprostata* : a., diverticulum of oesophagus; b., terminal portions of vas deferens and prostatic duct; 1. vas deferens; 2. prostatic duct.

communication with similar but shorter sinuses in the dorsal half of the oesophageal wall and through these with the dorsal vessel.

Towards the hind end of IX the lumen of the oesophagus gives off two diverticula into the thickened ventral wall. The diverticula run close together side by side, separated only by a blood sinus, and are lined by columnar epithelial cells of the same type as the cells that line the lumen of the oesophagus. In two series of sections the lower half of each diverticulum is seen to be 2-3 times as wide as the upper half (text-fig. 27a).

The oesophageal swelling in segment X has the same structure as in the previous segment and a similar pair of diverticula are present towards the hinder end of this segment.

The last hearts are in segment XI.

The excretory system is meganephridial. The nephridia are large from segment XIII onwards and bright yellow in colour.

Testes and sperm funnels are free in segments X and XI.

The seminal vesicles are two pairs in segments XI and XII. While the vesicles in segment XI are small and confined to that segment, those attached to septum 11/12 are larger and occupy segments XII and XIII.

A hardened mass of free spermatozoa is seen in segments X and XI.

Vasa deferentia.—In dissections only a single tube is seen on each side. Sections show that what looks like a single tube is really composed

of two distinct tubes bound together by a common epithelial covering and musculature (Plate V, fig. 62), the canals remaining separate till the end, where they open to the outside by a common orifice.

The prostates are a single pair, tubular, whitish and very long, extending through a large number of segments. In one specimen they extended back to segment XL, in another to XLIX, and in a third up to segment LIII. The two prostates are loosely coiled together in a few of the anterior segments. They run backwards in a slightly undulating manner, keeping very close together and sometimes twining round each other. The duct, which is 1.8 mm long, is thinner than the gland and somewhat shiny. The ectal end of the duct passes vertically downwards into the body wall to open to the outside. The ectal end of the vas deferens passes *below* the ectal end of the prostatic duct to open to the exterior immediately behind the prostatic pore (text-fig. 27b).

The glandular portion of the prostate is only one cell thick. The cells are elongated, broad at the periphery and narrow towards the lumen and uninucleated. The nuclei are situated usually near the periphery. Some sections in the series give the impression that the cells have more than one nucleus. I have satisfied myself that this impression is caused by the sections being more than one cell thick and by some cells not reaching quite up to the periphery but occupying the interstitial spaces between the bases of the longer cells. The cytoplasm, which is granulated, is only slightly stained by Delafield's haematoxylin. In the region of the duct the cells are very short and non-glandular (Plate V, fig. 60). This thin non-glandular part is surrounded by several layers of nucleated circular muscle fibres which in turn are covered by a layer of longitudinal fibres.

There are no penial setae.

The spermathecae are one pair in segment IX. The ampulla is a broad thin walled sac. The duct, which is sharply marked off, is about half as long as the ampulla and one-fourth its width. There is no diverticulum (Plate V, fig. 56).

Remarks.—The present species is distinguished from *M. paludicola* Steph. by the presence of only a single pair of prostates and by the much greater degree of fusion of the two vasa deferentia of each side.

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ON A COLLECTION OF AMPHIBIANS AND REPTILES FROM THE UPPER RECHAES OF THE BRAHMAPUTRA.

By MALCOLM A. SMITH, *M.R.C.S., L.R.C.P.*

I am indebted to the Director of the Zoological Survey of India for the privilege of examining a small collection of Amphibians and Reptiles obtained on different occasions during the last few years from Upper Assam and the extreme north of Burma. The region is but little known zoologically and any records concerning it therefore are of interest.

AMPHIBIANS.

***Rana cyanophlyctis* Schneid.**

A single juvenile specimen from the Phulcherra Tea Estate, Srimangal, Assam (S. W. Kemp coll.).

***Rana limnocharis* Wieg.**

Many specimens from Pung-ka-mem-john and Cantonment Hill, Cherrapungi, Assam (S. L. Hora coll.); Shillong, Assam. 5000 ft. (T. B. Fletcher coll.); Phulcherra Tea Estate (S. W. Kemp coll.).

Examples from these districts shew a rare form of coloration in that they have, in addition to a light vertebral line, a fine yellow streak extending along the back of the leg from above the vent to the external metatarsal tubercle.

***Rana hascheana* Stoliezka.**

Rana hascheana, Boulenger, *Rec. Ind. Mus.* XX, p. 54 (1920).

Rana limborgi, Boulenger, *ibid.* p. 56.

One adult male from Paukang, N. E. Burma, near the Tibetan frontier (Dr. Murray Stuart coll.).

Rana limborgi is said to differ from *R. hascheana* in having a larger and more prominent inner metatarsal tubercle and by the presence of tooth-like prominences in the front of the lower jaw as well as of vocal sacs in the male. I am unable to find any of these distinguishing characters in the specimens labelled *limborgi* and *hascheana* in the British Museum collection. Through the kindness of Professor Gestro of the Natural History Museum of Genoa, I have also been able to examine the specimen of *limborgi* figured in *Ann. Mus. Civ. Genova*, (2) XIII, 1893, p. 329, pl. X, in which the vocal sacs are said to shew externally as strong folds on either side of the throat. This specimen is exactly as figured (fig. 1a), but the folds have no connection with the mouth; they are not vocal sacs, but a part of the general cranial enlargement which occurs in the fully grown male of this species, and which can be seen also in other members of this group, particularly in those allied to *Rana macrognathus*.

R. limborgi Sclater therefore becomes a synonym of *R. hascheana* Stoliczka. The range of the species can be extended over the whole of the Indo-Chinese region, a specimen having been recently acquired by the British Museum from as far east as Thai-Nien in Tonkin.

***Rana alticola* Boulenger.**

Numerous tadpoles from Nong-priang stream, Cherrapungi (S. L. Hora coll.); Therriaghat, Khasi hills (R. Hodgart coll.); Wangjuti, N. E. Burma, near the Tibetan frontier (Dr. Murray Stuart coll.).

***Rana afghana* (Günth.).**

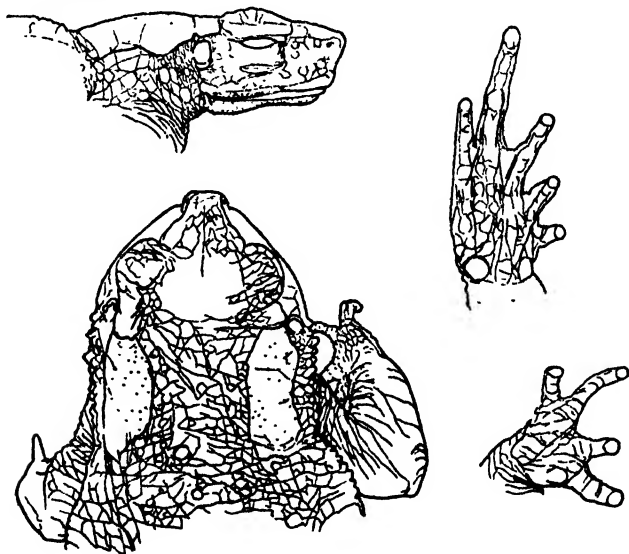
Rana latopalmata, Boulenger, *Rec. Ind. Mus.*, XX, p. 217 (1920).

Adults, juveniles and tadpoles from Shillong, 5,000 ft. (T. B. Fletcher coll.); Nong-priang stream, Cherrapungi and Therriaghat, Khasi hills (S. L. Hora coll.); Garo hills, Assam (S. W. Kemp coll.).

In 1924 (*Rec. Ind. Mus.*, XXVI, p. 139) I stated that the tadpole of *Rana livida* could be distinguished from that of *R. afghana* by the presence of a white V-shaped notch on the upper mandible. The above series of tadpoles, however, shews that this character cannot be relied upon and the tadpoles which I described then as *livida* I believe now to be those of *afghana*. The tadpole of *Rana livida* therefore is unknown.

***Bufo stuarti*, sp. nov.**

Description of the type. Adult male, collected on the Putao plain, N. E. Burma, near the Tibetan frontier, by Dr. Murray Stuart, after whom it is named.



TEXT-FIG. 1.—*Bufo stuarti*, sp. nov. Nat. size.

Habit like that of *B. melanostictus*. Crown without bony ridges; snout as long as the upper eyelid, prominent, projecting forwards beyond

the lower jaw ; canthus rostralis distinct ; loreal region almost vertical ; interorbital space a little broader than the upper eyelid ; tympanum distinct, half the diameter of the eye. First finger a little longer than second, third finger nearly twice as long as second ; two well marked carpal tubercles, the outer larger and flatter than the inner. Toes half webbed, the membrane not reaching the tips of the third and fifth toes ; subarticular tubercles single, not very prominent ; no tarsal fold ; two well marked metatarsal tubercles. The tarso-metatarsal articulation reaches to the tip of the snout ; the heels meet when the legs are folded at right angles to the body.

Skin of the head fairly smooth, of the back and limbs above with smooth warts of moderate size. Parotids well developed, elongate, twice as long as broad, parallel with each other. Skin of the lower parts coarsely granular. Nuptial asperities on the inner three fingers.

Pale olive above, uniform ; brownish-white below.

From snout to vent 73 mm.

Bufo stuarti is closely related to *B. stomaticus* Lutken from which it can be distinguished by the more prominent snout, the strong canthal ridges and by the absence of a tarsal fold.

Megalophrys major Boulenger.

Megalophrys major, Boulenger, *Proc. Zool. Soc., London*, 1908, p. 416.

One adult example from above Tura, Garo hills (Mrs. S. W. Kemp).

LIZARDS.

Cosymbotus platyurus (Schneid.).

Hemidactylus platyurus, Boulenger, *Fauna Brit. Ind.*, 1890, p. 95.

Two examples from Shillong (Col. R. B. S. Sewell coll.).

Draco maculatus (Gray).

One example from the Naga hills, Assam (Dr. J. H. Hutton coll.)

Draco norvillii Alcock.

Alcock, *Journ. Asiat. Soc. Bengal*, LXIV, pt. 2, p. 14, pl. iii (1895).

A female specimen from the Naga hills, Assam (Dr. J. H. Hutton coll.).

It is the second specimen known. With the exception of a slight difference in the coloration of the patagium it agrees well with the description of the type, a male, from Doom Dooma, Upper Assam. Both sexes now being known it will be convenient to redescribe the species.

Head small ; snout a little longer than the diameter of the orbit ; nostrils directed vertically upwards ; tympanum covered with small scales. Upper head shields unequal, strongly keeled ; a small subconical tubercle at the posterior part of supraciliary edge ; nine or ten supralabials. Gular appendage of the male a little longer than the head, covered with large scales, of the female less than half the length of the head.

Dorsal scales unequal, smooth or feebly keeled, the largest about as large as the ventrals which are strongly keeled ; a dorso-lateral series of distant, enlarged subtriangular scales. The fore-limb extends to well beyond the tip of the snout, the hind limb to the axilla. Male with a slight nuchal fold ; no caudal crest.

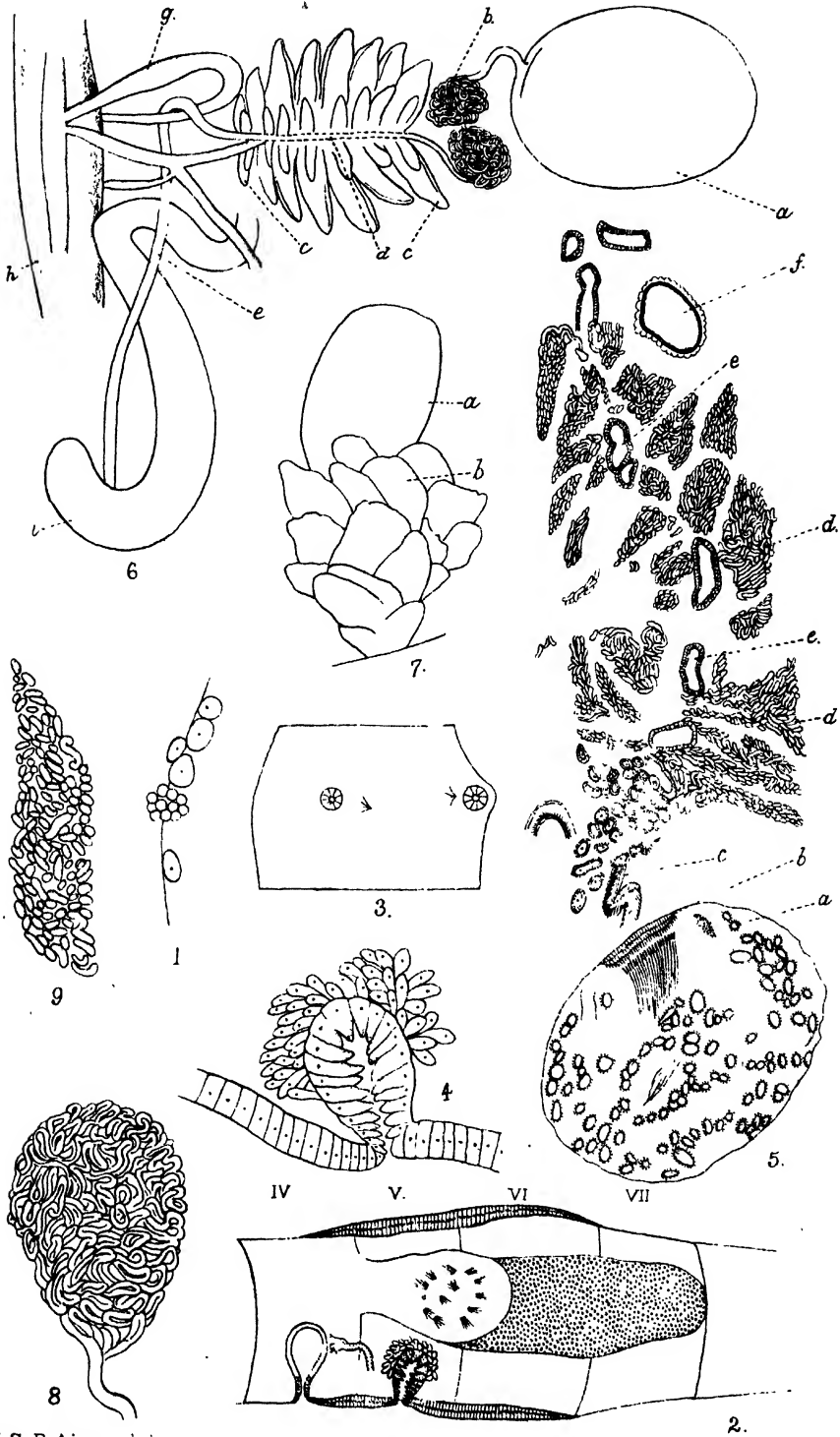
Greyish or bronzy above, with metallic tints and darker spots ; a more or less distinct light transverse bar across the middle of the back. Patagium of the male with three dull red (scarlet in life) transverse bands above, which bifurcate as they approach the body. In the female the first band and inner parts of the second and third bands are dark brown. Beneath immaculate. Gular appendage pale lemon in life ; inside of wattles red.

From snout to vent 175 ; tail 200 mm.

Range.—Upper Assam.

EXPLANATION OF PLATE I.

- FIG. 1.—*Aeolosoma travancorense* ; a portion of the wall of the dorsal blood vessel with male cells and morulae, diagrammatic.
- „ 2.—*Stephensonia trivandran*a ; genital organs, diagrammatic.
- „ 3.—The same ; male apertures and penial setae.
- „ 4.—The same ; atrium with prostatic cells.
- „ 5.—*Moniligaster deshayesi* ; longitudinal section of testis sac and glands ; *a.*, sperm morula ; *b.*, funnel ; *c.*, vas deferens ; *d.*, glands ; *e.*, vas deferens in the region of the glands ; *f.*, heart.
- „ 6.—The same ; dissection showing course of vas deferens on right side. (The testis sac with the attached glands is shifted over to the extreme right and pinned). *a.*, testis sac ; *b.*, vas deferens coiled ; *c.*, glands ; *d.*, vas deferens passing through the gland region ; *e.*, vas deferens after emergence from the gland region ; *h.*, alimentary canal ; *i.*, prostate.
- „ 7.—The same ; testis sac with attached cluster of leaf-like glands. *a.*, testis sac ; *b.*, glands.
- „ 8.—The same ; one gland, magnified, semi-diagrammatic.
- „ 9.—The same ; longitudinal section of a gland.

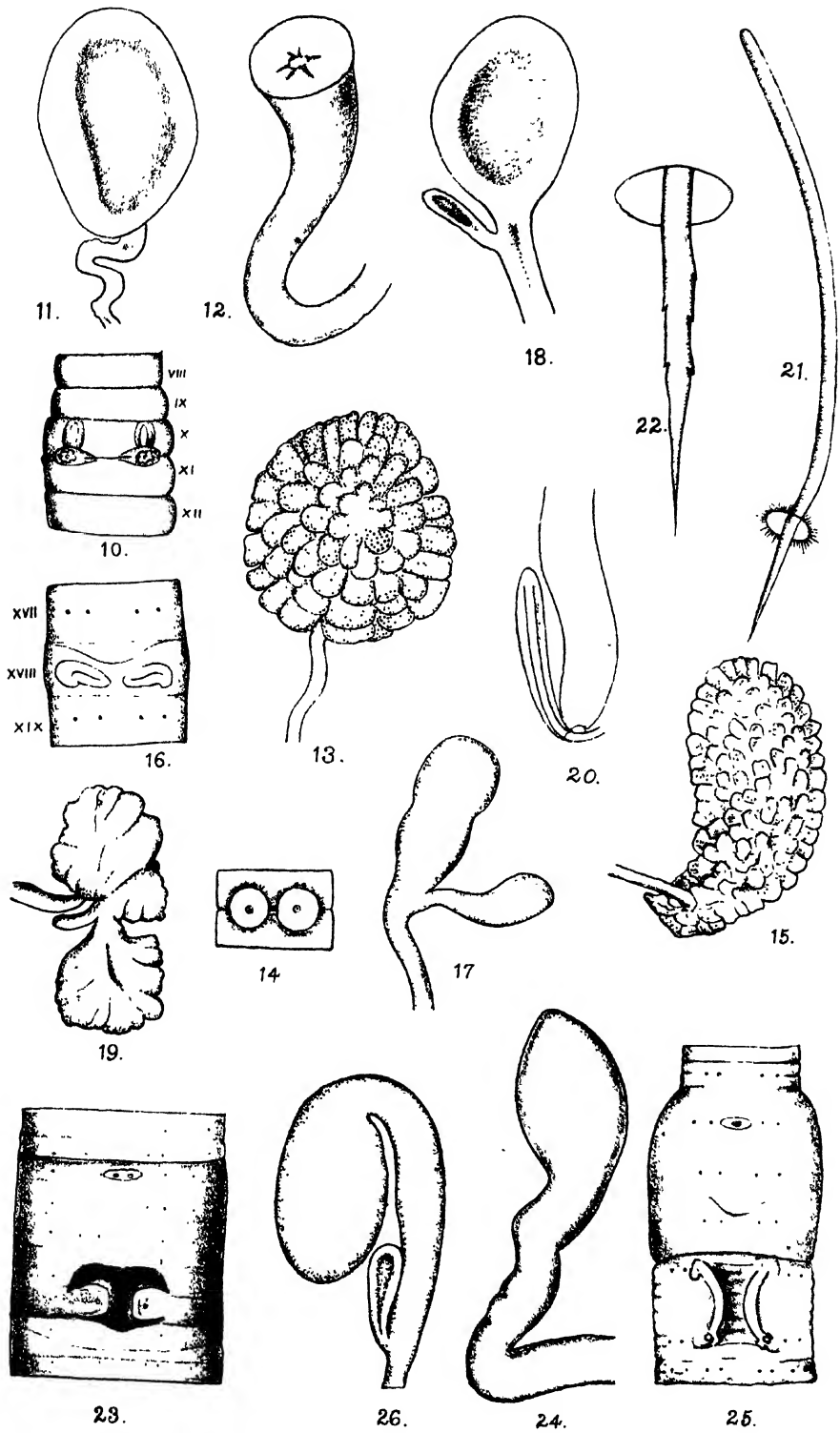


K.S.P. Aiyer del.

TRIVANCORE OLIGOCHAETA.

EXPLANATION OF PLATE II.

- FIG. 10.—*Drawida barwelli* var. *impertusa* ; male genital field.
,, 11.—The same ; spermathecal ampulla and the beginning of duct, $\times 70$.
,, 12.—The same ; thickened ectal end of spermathecal duct, $\times 112$.
,, 13.—The same ; prostate with vas deferens entering into it.
,, 14.—*Drawida circumpapillatus* ; male field.
,, 15.—The same ; prostate with vas deferens entering into it.
,, 16.—*Plutellus variabilis* ; male genital field.
,, 17.—The same ; spermatheca, $\times 70$.
,, 18.—*Woodwardiella kayankulamensis* ; spermatheca, $\times 70$.
,, 19.—The same ; prostate.
,, 20.—The same ; end of prostatic duct with penial setal sac.
,, 21.—The same ; penial seta, $\times 420$.
,, 22.—The same ; distal end of penial seta more highly magnified.
,, 23.—*Megascolides chengannures* ; clitellum.
,, 24.—The same ; spermatheca, $\times 40$.
,, 25.—*Notoscolex tenmalai* var. *ghatensis* ; clitellum and male genital field.
,, 26.—The same ; spermatheca.

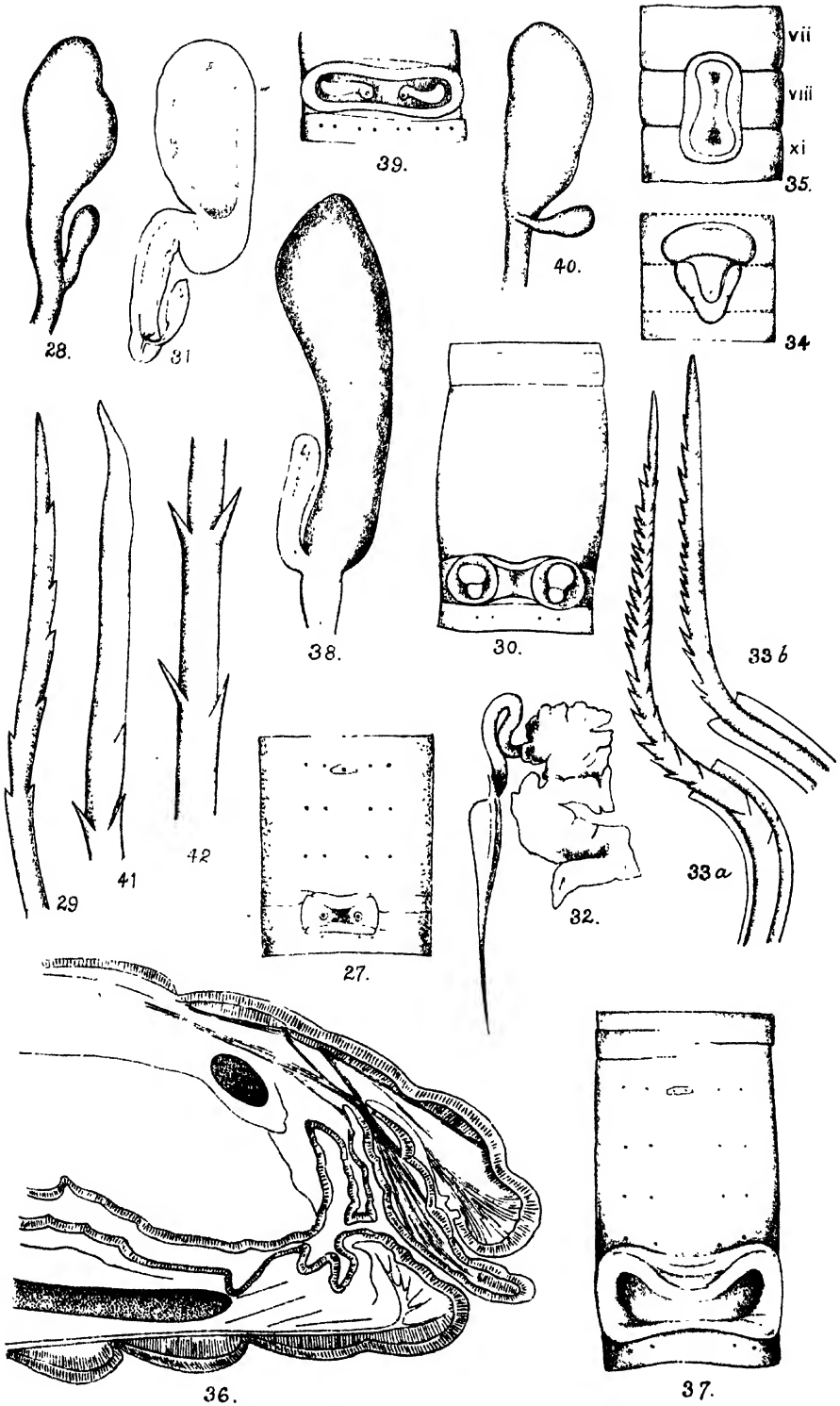


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TRIVANDRUM OLIGOCHAETA.

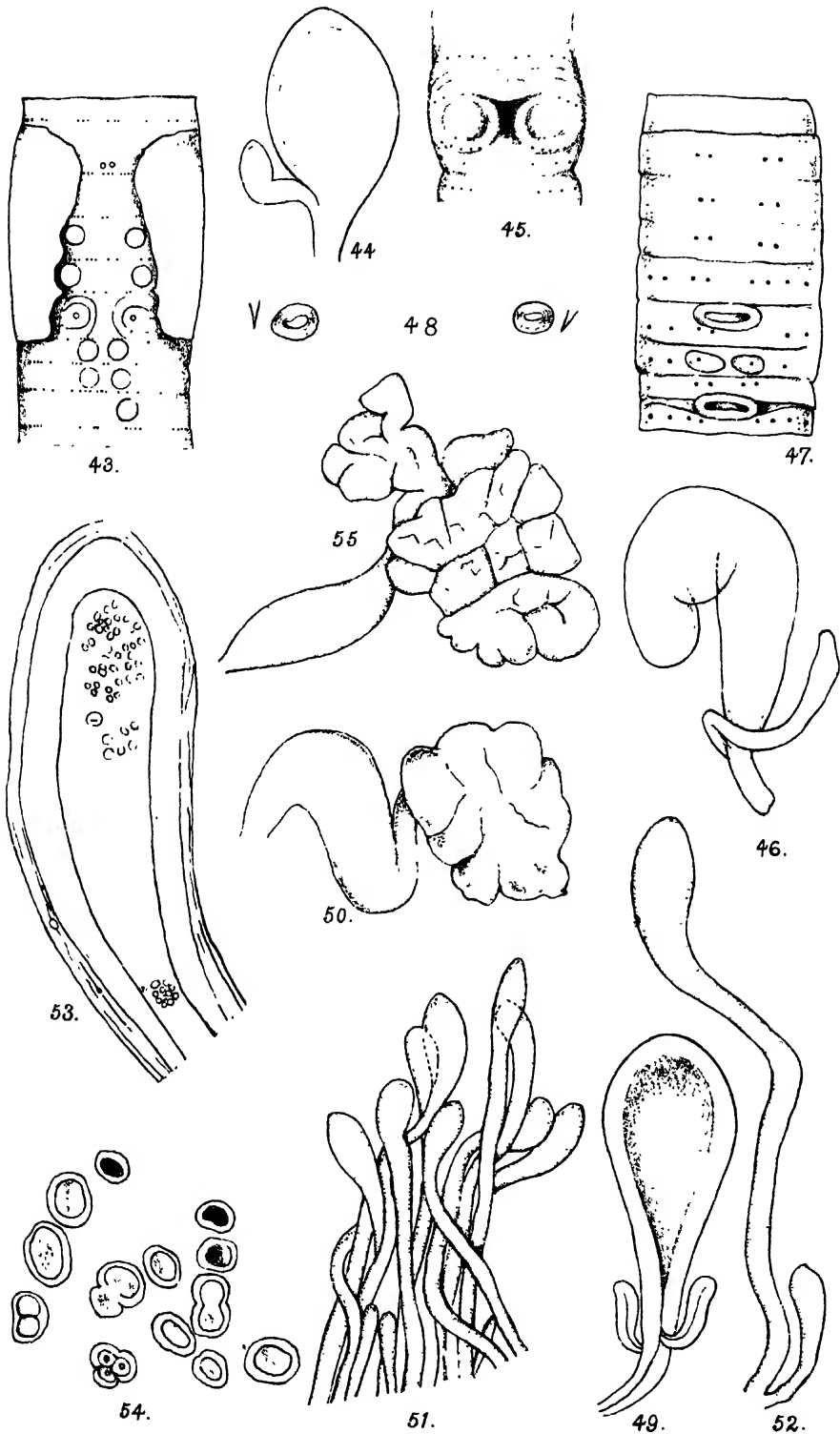
EXPLANATION OF PLATE III.

- FIG. 27.—*Notoscolex peermadensis* ; clitellum and male genital field.
,, 28.—The same ; spermatheca, $\times 40$.
,, 29.—The same ; distal end of penial seta, $\times 1800$.
,, 30.—*Notoscolex travancorensis* ; clitellum and male genital field.
,, 31.—The same ; spermatheca.
,, 32.—*Notoscolex minimus* ; prostate with duct and penial setal sac.
,, 33.—The same ; distal end of penial seta, $\times 1400$.
,, 34.—*Megascolex travancorensis* var. *proboscidea* ; male genital field.
,, 35.—The same ; copulatory cushion.
,, 36.—The same ; longitudinal section of the anterior end of the body showing proboscis.
,, 37.—*Megascolex auriculata* ; clitellum and male genital field.
,, 38.—The same ; spermatheca.
,, 39.—*Megascolex avicula*, male genital field.
,, 40.—The same ; spermatheca, $\times 40$.
,, 41.—The same ; distal end of penial seta, $\times 3000$.
,, 42.—The same ; portion of penial seta below the tip showing spines in pairs, \times about 3000.



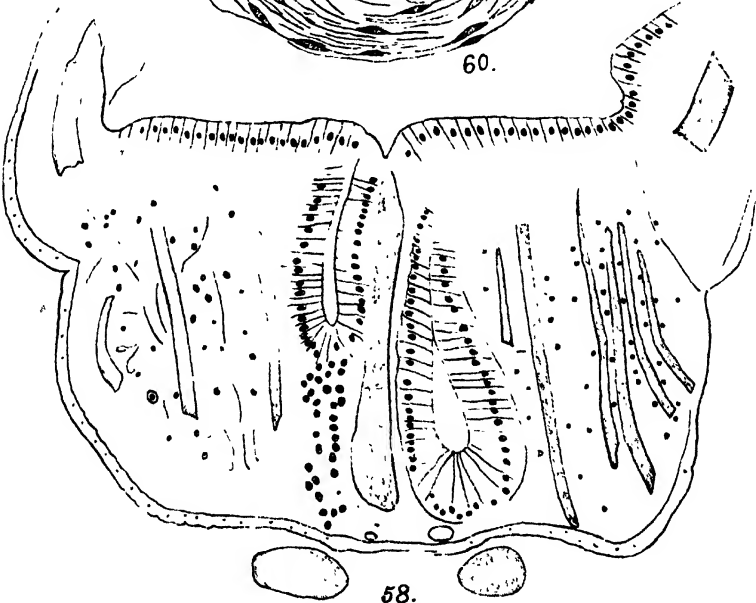
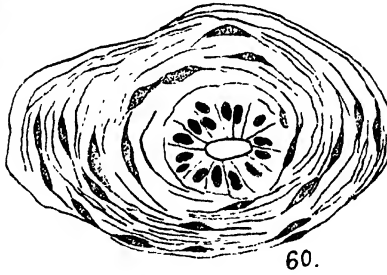
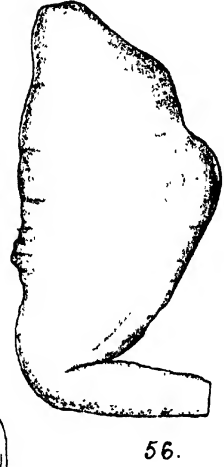
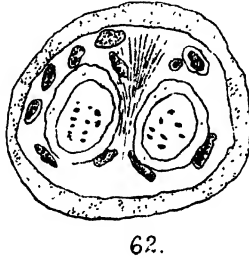
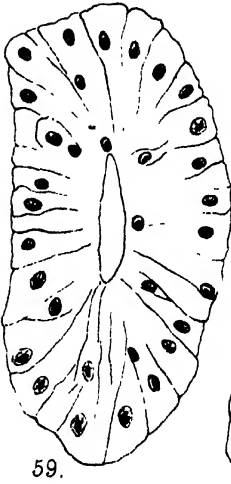
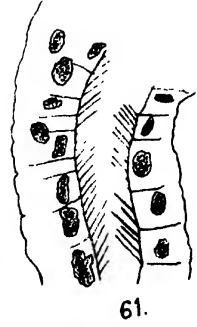
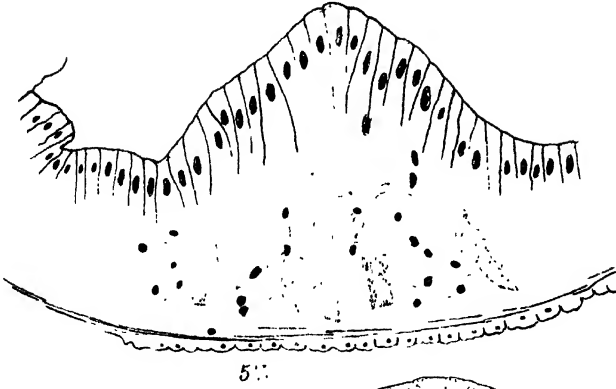
EXPLANATION OF PLATE IV.

- FIG. 43.—*Megascolex ratus* ; clitellum and male genital field.
,, 44.—*Notoscolex minimus* ; spermatheca, $\times 70$.
,, 45.—*Megascolex peermadensis* ; male genital field.
,, 46.—The same ; spermatheca, $\times 40$.
,, 47.—*Megascolex kumiliensis* ; clitellum and male genital field.
,, 48.—The same ; spermathecal apertures.
,, 49.—The same ; spermatheca, $\times 40$.
,, 50.—The same ; prostate.
,, 51.—*Megascolex polytheca* var. *uniquus* ; spermathecae.
,, 52.—The same ; spermatheca, $\times 70$.
,, 53.—The same ; spermatheca after clearing.
,, 54.—The same ; protococci taken from spermathecal ampulla.
,, 55.—The same ; prostate.



EXPLANATION OF PLATE V.

- FIG. 56.—*Malabaria biprostata* ; spermatheca, $\times 70$.
,, 57.—The same ; transverse section of ventral wall of oesophagus in anterior part of segment IX.
,, 58.—The same ; transverse section of ventral wall of oesophagus in posterior part of segment IX, showing the much thickened wall, the diverticula, blood layers, vessels on the ventral side of the oesophagus, etc.
,, 59.—The same ; transverse section of prostate, $\times 640$.
,, 60.—The same ; transverse section of prostatic duct, $\times 640$.
,, 61.—The same ; longitudinal section of a vas deferens before the two vasa deferentia of a side unite.
,, 62.—The same ; transverse section of the fused vasa deferentia.



K.S.Paiyer del.

TRAVANCORE OLIGOCHAETA.

ON THE SEXUAL ORGANS OF THE TUBIFICID WORM *AULODRILUS REMEX* STEPH.

By K. S. PADMANABHA AIYER, M.A., D.Sc.

(Plate VI).

This species was originally described by Stephenson in 1921 (4) from three specimens collected in the Central Provinces. Large numbers of the worm, mostly non-sexual, were found by me in tanks in Trivandrum in 1925 (1). In August, 1928 a sample of mud containing specimens of the worm was brought from Neyyur (34 miles south of Trivandrum) and kept in the laboratory for 3 months. Sexual specimens became available in this culture during the months of October and November. Six of these were sectioned longitudinally, four transversely, and several were examined alive under the microscope.

The present specimens measure 15-20mm. during life. The number of segments is usually more than 100. One of the largest specimens examined had 156 segments followed by a short setaless unsegmented region.

The prostomium is bluntly conical. The buccal cavity is globular and is confined to segment i. The pharynx is thick-walled and occupies segments ii and iii. Surrounding the pharynx are a number of pear-shaped cells, the basal ends of which are drawn out into long narrow ducts. The narrow oesophagus dilates into the intestine in segment vii or viii. In sexually mature specimens the dilatation is in segment ix.

Large clusters of pear-shaped gland-cells occur in segments iii, iv, and v close to the ventral bodywall on either side of the ventral nerve cord. The cells have finely reticulate cytoplasm and round nuclei and their narrow basal ends are attached to the bodywall.

On the ventral side of segment vii, in sexually mature specimens, is a narrow median longitudinal opening with a puckered margin.

The opening alternately widens and narrows to a slit as the body of the animal contracts and expands during progression. The opening leads into a cavity or depression formed by the invagination of the bodywall, which may be termed the 'genital fossa' since the male apertures open into it. Such a depression has been described by Mehra (3) in *A. kashi* and termed by him the 'spermiducal chamber.' I would prefer the term 'genital fossa.'

The Reproductive Organs.

The clitellum is conspicuous and extends over segment vii and the anterior half of segment viii ($=1\frac{1}{2}$ segments).

The testes were present in all the sectioned specimens. They are a pair of pear-shaped masses of cells in segment vi attached by the narrow base to the posterior face of septum 5/6. In all the specimens examined there is present in segment v and attached to septum 4/5

by their narrow bases a pair of structures similar to the testes in segment vi, but about half their size. These appear to be an anterior rudimentary and perhaps functionless pair of testes.

The sperm sac is single and occupies segment vii and may project into segment viii. Spermatozoa and sperm-morulae are seen in segment vi, in some specimens sparsely and in others abundantly.

The male funnels are placed on the anterior face of septum 6/7, one on each side of the oesophagus and a little below it. The funnels are almost equilateral in longitudinal section, and are 45-60 μ wide at the mouth, according as they are partially or fully open. The wall is composed of a single layer of narrow elongate columnar cells and is ciliated internally. Bundles of spermatozoa are seen at the mouth.

The vas deferens is 12 μ thick with a lumen about 5 μ in diameter. On passing into segment vii the vas deferens describes a broad loop, gradually rises upwards, and opens into the atrium at its anterior end. In a few sections the distal half of the duct is slightly coiled.

The atria are elongate ovoid sacs in segment vii with their long axis parallel to that of the body. Each atrium is 157 μ long, 67 μ wide at the broad anterior part, and 31 μ at the narrow rounded posterior end. The wall of the atrium is composed of three layers as in the other species of the genus. The inner epithelial lining consists of broad columnar cells with indistinct granules and basal nuclei. The nuclei alone stain with haematoxylin. The cells lining the anterior end of the atrium are smaller and are ciliated. The middle muscular coat is distinct and is 3.6 μ in thickness. The outer coelomic epithelium is rather indistinct in sections. Twisted bundles of spermatozoa are present in the lumen of the atrium.

From the ventral side of the rounded posterior end of each atrium the straight atrial duct is given off, which, passing downwards and inwards towards the middle line, opens along with its fellow into the genital fossa at about its middle. The duct is distinctly marked off from the atrium by a constriction and is 72 μ high and 30 μ thick. At the constriction it is only 18 μ thick. The columnar cells lining the lumen are of the same kind as those of the atrium. This epithelial layer is surrounded by a layer of circular muscle-fibres, which at the exterior opening of the duct form a distinct sphincter round it. The entire duct is enclosed in a muscular chamber composed of longitudinal muscle-fibres springing from the ventral bodywall.

Lying on the ventral side of each atrium is the prostate, a lobed mass composed of large pear-shaped gland-cells with finely-reticulate cytoplasm and small rounded nuclei. Both the reticulum and the nuclei stain deeply with haematoxylin. The prostate communicates with the atrium ventro-laterally at about the middle of its length where the muscular coat of the atrium is interrupted.

The ovaries are in segment vii attached to the ventral bodywall close behind septum 6/7. Each is broad and flat, about 160 μ in length and is composed of a large number of ova a few of which are sometimes larger in size than the rest.

The ovisac is in segment viii, sometimes projecting slightly into segment ix. It is a backward pouching of septum 7/8 and contains a

single large ovum composed of minute rounded yolk granules and having a conspicuous centrally-situated oval nucleus with a nucleolus.

A pair of spermathecae are situated in segment vi, and each consists of an ampulla and duct. The ampulla is an ovoid sac 247μ long, 54μ wide at its ental end, 67μ wide about the middle and 27μ ectally. The wall is composed of a single layer of cubical cells with a thin muscular layer closely adherent to it. The lumen of the ampulla is filled with a twisted mass of tightly packed spermatozoa. The duct is 45μ long and 18μ thick. The two ducts open close together in the mid-ventral line in the setal zone of the segment.

The coelomic cavity of segment vi.—Mehra (3) describes in detail a division of the coelomic cavity of segment vi in *A. kashi* into two parts, a large central portion enclosing all the organs of the segment and a more peripheral surrounding the former ventrally and laterally. I give below an account of the condition observed in the present species.

In one of the series of transverse sections (the best of the four prepared) the bodywall of segment vi is very much thickened laterally and ventrally (but not dorsally). The thickness is caused by the development of a new layer of circular muscle-fibres at some distance from the bodywall and the filling up of the space between the two by a spongy tissue composed of irregularly shaped cells with reticulate cytoplasm and round nuclei. Numerous spaces exist in this tissue. The spongy tissue, which is widest ventrally, gets narrower and narrower dorsward till it completely disappears dorso-laterally where the new muscular wall joins the bodywall. In transverse sections the thickened part of the bodywall has thus the appearance of a crescent. In a few of the sections of this series the new muscular wall has, in certain places, severed itself almost completely from the bodywall, the only connection between the two being very thin protoplasmic strands, remnants of the spongy network, at wide intervals (see Pl. VI, fig. 7). The strands may also be broken or absent. Thus distinct peripheral spaces result. These spaces can be due to nothing else than the accidental tearing of the loose spongy network during the process of paraffin embedding.

In the remaining three of my transverse series an almost continuous peripheral cavity occurs laterally and ventrally. In these sections the spongy tissue is present only in the dorso-lateral corners just before the new circular muscle layer fuses with the bodywall. After having examined the condition in the first series described above I think that the apparently continuous peripheral cavity in these is also caused by the accidental tearing of the loose spongy network during the process of paraffin embedding, and the consequent separation of the new layer of circular muscle-fibres from the bodywall.

With regard to the origin of the spongy tissue and the development of the new circular layer of muscles in segment vi I am unable to give a definite explanation. It may, however, be mentioned that in the present species the thickening of the bodywall is not restricted to segment vi but extends slightly into the posterior part of segment v and into the anterior part of segment vii.

Penial setae.—In sexually mature specimens the ventral setae of segment vi are lost and those of segment vii are modified as the penial

setae. The penial setae are *one* only on each side in fully-mature individuals, though in less mature worms two setae are present in a bundle. The penial seta is 135—144 μ long and doubly curved and is without a nodulus. The distal fourth of the seta has a boat-like excavation on its concave side as in *A. pectinatus* (2).

Each penial seta passes through the central lumen of a setal gland situated external to the atrial duct of its side. The setal gland is 36 μ wide and is almost globular in shape. It is composed of a single layer of elongate cells having distinct outlines and basally situated nuclei. The cytoplasm does not stain with haematoxylin. The proximal part of the penial seta projects beyond the gland for a distance of about 36 μ . Investing the gland is a muscular layer which is continuous with the muscle bands of the setal sac.

Small compact pear-shaped masses of gland-cells occur in connection with each setal gland, as in *A. pectinatus* and *A. kashi*. The cells composing each pear-shaped mass are themselves pear-shaped and highly vacuolated. The long narrow stalk-like basal end of each mass (composed of the extremely long, thin and stalk-like basal ends of the individual cells) communicates with the setal gland. Communication is effected by the interruption of the muscle layer investing the setal gland. While the swollen parts of the cells stain deeply with haematoxylin, the narrow basal parts do not stain.

Parasites.—In two non-sexual specimens the body presented whitish blotches on each side except in the posterior segments. On examination it was seen that the whitish appearance was due to the presence, in the body-cavity of each segment, of two massive bundles, one on each side of the gut, of a species of bacterium. Each bacterium is 19 μ long, straight, and rod-like, with an ovoid spore (?) near the anterior end. This is the second time I have noticed bacterial infection in aquatic oligochaetes. Some months ago a specimen of *Aulophorus tonkinensis* was obtained with the entire body swollen and which presented a glistening white appearance due to masses of bacteria in the body-cavity.

Remarks.—The presence of two pairs of testes in the present species is interesting. The anterior pair have apparently lost their function as is indicated by their small size and by the absence of an anterior pair of male funnels and of an anterior sperm-sac. In other respects the present species agrees very closely with *A. kashi*. Among minor differences may be mentioned the following:—

- (1) The atrial duct in *A. remex* is straight and not convoluted.
- (2) The spermathecal openings in *A. remex* are *ventral*, close to the mid-ventral line and not ventro-lateral as in *A. kashi*.

REFERENCES TO LITERATURE.

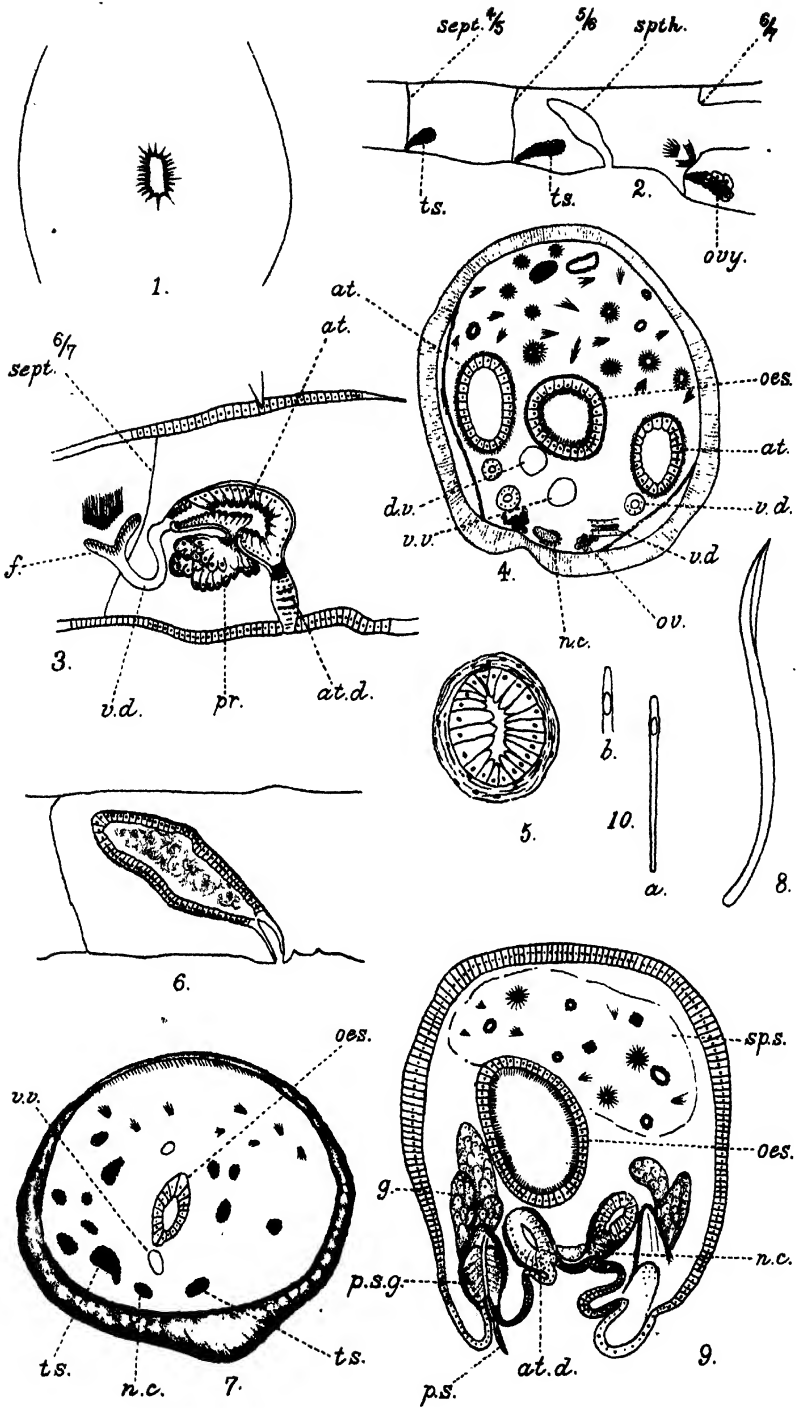
1. Aiyer, K. S. Padmanabha.—Notes on the Aquatic Oligochaeta of Travancore, I. *Ann. Mag. Nat. Hist.*, (Ser. 9), Vol. XV (1925).
2. Aiyer, K. S. Padmanabha.—On a new species of the Oligochaete genus *Aulodrilus* Bretscher. *Rec. Ind. Mus.* Vol. XXX, Part III (1928).
3. Mehra, H. R.—Two New Indian species of the genus *Aulodrilus* Bretscher. *Proc. Zool. Soc. London* (1922).

4. Stephenson, J.—Oligochaeta from Manipur, the Laccadive Islands, Mysore, and other parts of India. *Rec. Ind. Mus.* Vol. XXII, Part V (1921).
5. Stephenson, J.—Fauna of British India. Oligochaeta. (London, 1923).
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EXPLANATION OF PLATE VI.

Aulodrilus remex Steph.

- FIG. 1.—Genital fossa on the ventral side of segment VII.
- FIG. 2.—Testes, ovaries and spermathecae. *t*, testes, *ovy*, ovary ; *sph*, spermatheca.
- FIG. 3.—Male deferent apparatus, diagrammatic. *at*, atrium ; *at. d* atrial duct ; *f*, funnel ; *pr*, prostate ; *vd*, vas deferens.
- FIG. 4.—Transverse section through atrium in segment VII before vas deferens opens into it. *oes*, oesophagus ; *at*, atrium ; *d.v*, dorsal vessel ; *nc*, nerve cord ; *vd*, vas deferens ; *v.v*, ventral vessel.
- FIG. 5.—Transverse section through atrial duct.
- FIG. 6.—Spermatheca.
- FIG. 7.—Transverse section through segment VI. *oes*, oesophagus ; *n. c*, nerve cord ; *t*, testes, *v. v*, ventral vessel.
- FIG. 8.—Penial seta.
- FIG. 9.—Transverse section through the middle of segment VII passing through the atrial ducts and the penial setal glands. *at. d*, atrial duct ; *g*, masses of gland cells ; *p. s. g.* penial setal gland ; *ps*, penial seta ; *n. c*, nerve cord ; *sp. s*, sperm-sac.
- FIG. 10.—Bacterium. *a*, entire bacterium ; *b*, anterior end, more magnified.



K.S.P. Aiyer del.

Aulodrilus remex Steph.

TWO NEW SPECIES OF NEMATODES FROM INDIAN HOSTS.

By P. A. MAPLESTONE, D.S.O., M.B., Ch. B., D.T.M.

(From the Hookworm Research Laboratory, School of Tropical Medicine and Hygiene, Calcutta. Financed by the Indian Jute Mills Association).

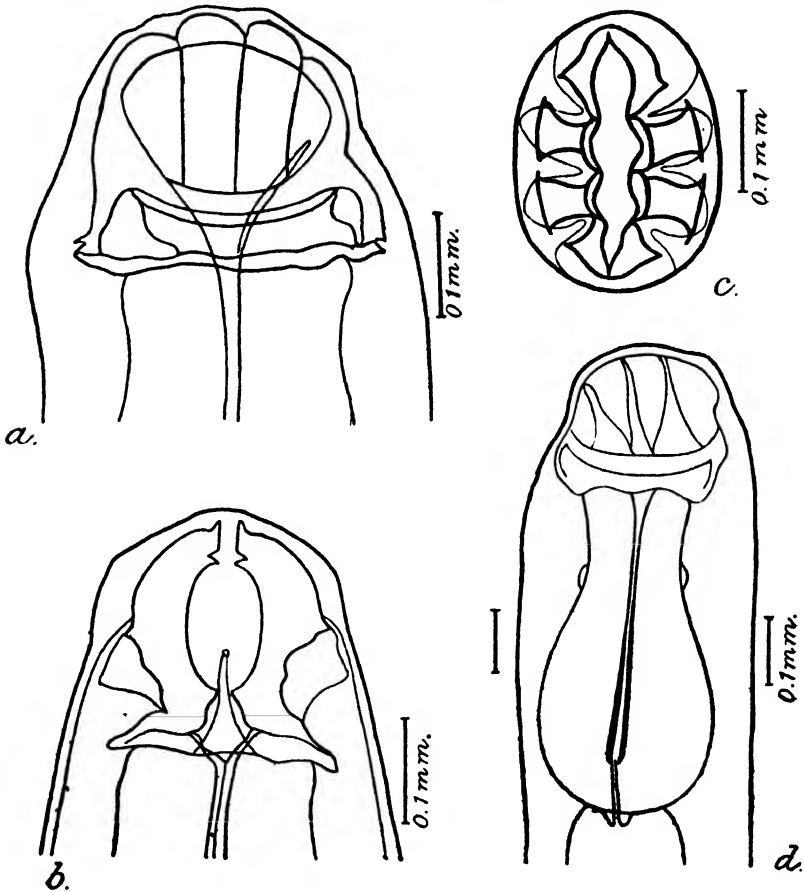
Kalicephalus bengalensis, n. sp.

Host.—*Zamenis mucosus* (Rat-Snake).

Locality.—India.

Site.—Intestine.

Material available for study. Three males and ten females.



TEXT-FIG. 1.—*Kalicephalus bengalensis*, n. sp.

a. Head, lateral view. Deep focus to show grooves in the capsule wall.

b. Head, dorso-ventral view.

c. Head, end on view. Deep focus to show structure of buccal capsule. (Papillae superimposed).

d. Head, lateral view. Superficial focus to show papillae.

These worms were obtained from two specimens of the rat-snake which died in the Calcutta Zoological Gardens.

The body tapers gradually from before backwards, the head being relatively broad in the dorso-ventral diameter. The mouth is in the form of a dorso-ventral slit looking straight forwards and it is bounded by two broadly-rounded lateral lips (figs. 1*a*, *c*, *d*). Each lip bears three papillae (fig. 1*d*). The papillae of each lip overlie three deep longitudinal grooves in the buccal capsule, which extend almost through its whole thickness (fig. 1*c*). Dorso-ventrally, in optical section, the cavity of the capsule is oval, and there is a groove on its inner surface towards the anterior, where the lateral walls come together (fig. 1*b*). The duct of the dorsal oesophageal gland opens about half way up the depth of the capsule. At its junction with the oesophagus the buccal capsule is reinforced by triangular plates and transverse bars of chitin (figs. 1*a*, *b*).

The oesophagus is short, thick, and flask-shaped, and the maximum diameter of its bulb is equal to about half its length, its lumen is lined by chitin for the greater part of its length, and this lining becomes gradually thicker from before backwards. The nerve-ring surrounds the oesophagus at its narrowest part, which is at about the junction of the anterior and middle thirds (fig. 1*d*).

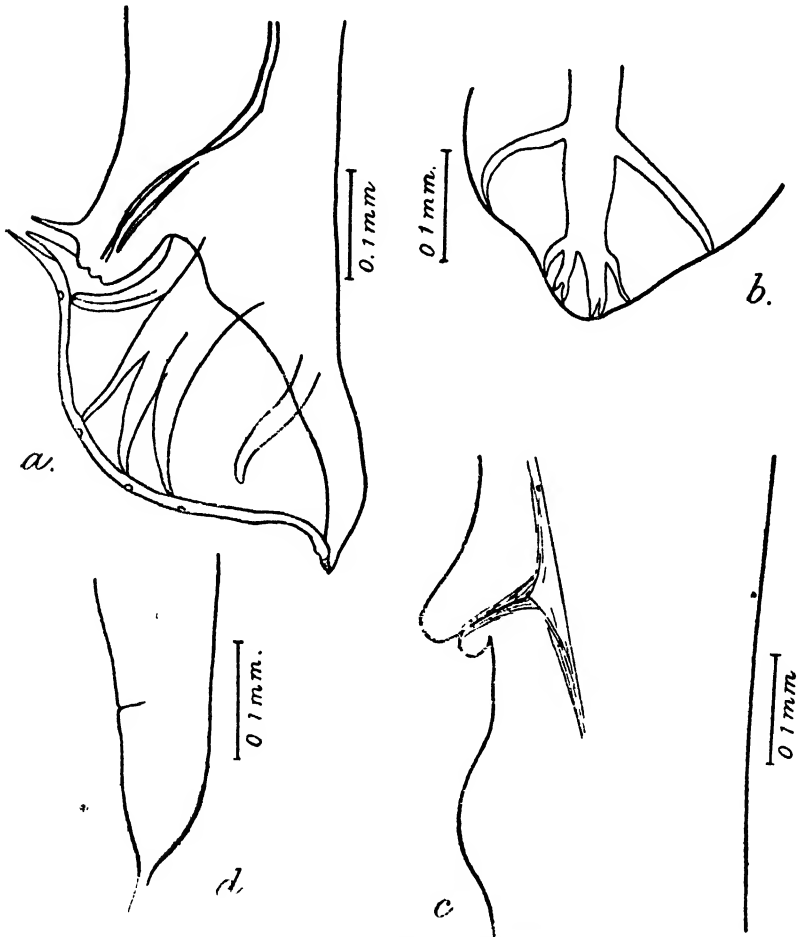
Male.—The rays of the male bursa are very similar to those of other members of the genus, the only special characters noted being that the bursa ends in two sharp points ventrally, and that from each side of the genital cone a relatively long, pointed pre-bursal papilla arises (figs. 2*a*, *b*). The spicules are long, equal and thin, they are only slightly thicker at their bases than at their faintly alate tips. About the middle of their length they take a broad curve towards the ventral surface of the worm. A gubernaculum is present, it is in the form of a long delicate rod of chitin (fig. 2*a*).

Female.—The vulva opens on a prominent cone consisting of two lips, and just behind this cone there is a distinct bulbar enlargement (fig. 2*c*). Immediately posterior to this the worm becomes distinctly narrower, and from this point it gradually tapers to the tail, which is in the form of a sharp cuticular spike (fig. 2*d*). The short vagina runs directly inwards and ends in two ovijectors, which run straight backwards and forwards respectively. About halfway between the vulva and anus the posterior ovijector turns forwards into the uterus which runs forwards parallel to the uterine branch arising from the anterior ovijector.

Measurements.

| | | | | |
|--|----|----|----|-------------------------|
| Male, length | .. | .. | .. | 6—7 mm. |
| „ maximum breadth | .. | .. | .. | 0.26 mm. |
| Female, length | .. | .. | .. | 7—9 mm. |
| „ maximum breadth | .. | .. | .. | 0.36 mm. |
| Oesophagus | .. | .. | .. | 0.34 mm. |
| Nerve-ring from ant. end of oesophagus | .. | .. | .. | 0.15 mm. |
| Spicules, length | .. | .. | .. | 0.35 mm. |
| Gubernaculum | .. | .. | .. | 0.12 mm. |
| Vulva from tip of tail | .. | .. | .. | 2.08 mm. |
| Divides worm approximately | .. | .. | .. | 1.4. |
| Anus from tip of tail (female) | .. | .. | .. | 0.16 mm. |
| Eggs | .. | .. | .. | 0.066 0.070 × 0.040 mm. |

In size this worm is almost identical with *Kalicephalus indicus* Ortlepp¹ (1923), which was found in the same host; but there are several points of difference in the anatomy which, in the writer's opinion, justify the creation of a new species. In the male the sharp points in which the bursa ends ventrally, and the pre-bursal papillae are absent in *K. indicus*. In the female the vulva opens between prominent lips and there is a post-vulvar enlargement in *K. bengalensis*, whereas these structures are absent in *K. indicus*; the diminution in diameter posterior to the vulva is not nearly so marked in the former as it is in the latter species; the



TEXT-FIG. 2.—*Kalicephalus bengalensis*, n. sp.

a. Male bursa, lateral view.
b. Male bursa, dorsal lobe.

c. Female, region of vulva.
d. Female tail.

ovijectors definitely diverge for a considerable distance and the eggs are larger in the former species than they are in *K. indicus*.

¹ Ortlepp, R. J. (1923). Observations on the Nematode Genera *Kalicephalus*, *Diaphanocephalus*, and *Occipitodontus* g. n., and on the larval development of *Kalicephalus philodryadus* sp. n. *Journ. of Helminthology*, Vol. I, p. 165.

According to the descriptions given by Ortlepp (1923) this worm differs markedly from all other species of the genus.

Type-specimens have been placed in the Indian Museum, Calcutta.

***Habronema indica*, n. sp.**

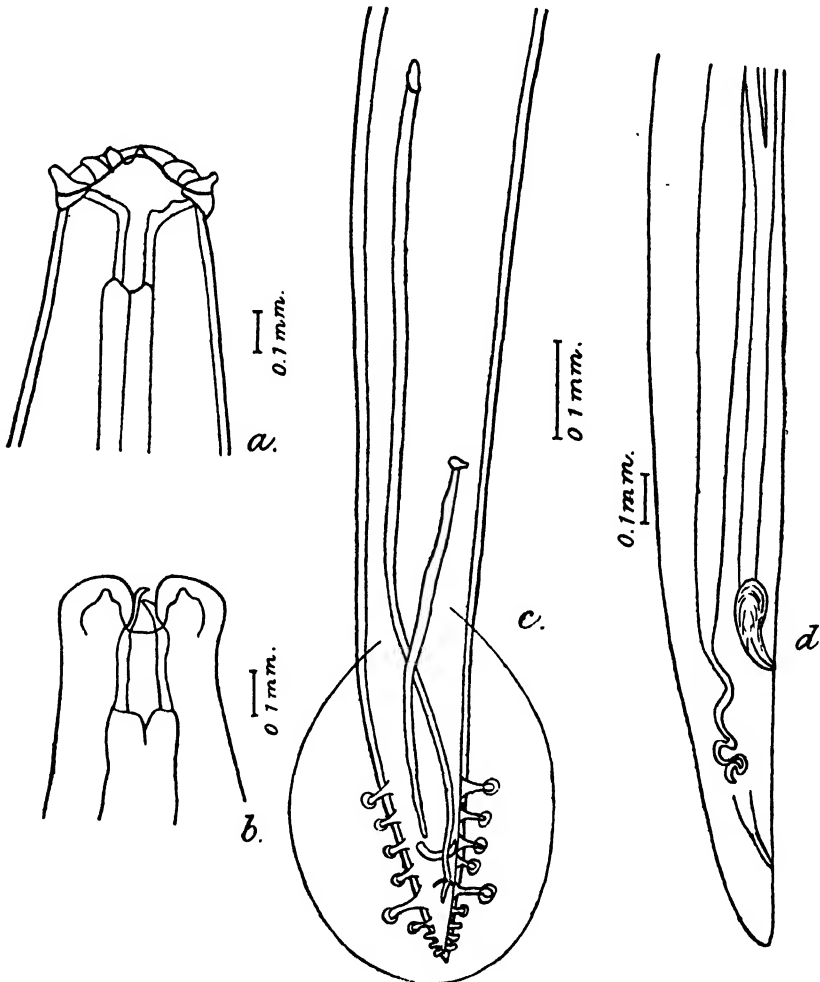
Host.—*Coracias indica* (Indian Roller).

Locality.—India.

Site.—Gizzard.

Material available for study. One male and three females.

These worms were obtained from a bird that died in the Calcutta Zoological Gardens.



TEXT-FIG. 3.—*Habronema indica*, n. sp.

a. Head, lateral view.

b. Head, dorso-ventral view.

c. Posterior extremity, male, ventral view.

d. Posterior extremity, female, lateral view.

The head is fairly small, being only about one-third of the maximum diameter of the body. The cuticle has two sets of transverse striations ;

a set of fine striations about 3μ apart and a set of coarser striations about 18μ apart. The mouth is in the form of a dorso-ventral slit, and it is bounded by two thick lateral lips each of which bears a large pointed sub-dorsal and sub-ventral papilla. On the inner surface of each lip there are four chitinous teeth which lightly interlock with those of the opposite side (fig. 3a, b). The vestibule is strongly chitinated and in the anterior portion it rapidly expands dorsally and ventrally (fig. 3a). It is produced anteriorly as a thin chitinous plate, the serrated border of which forms the teeth. The oesophagus is long and thin and it is divided into a short anterior muscular portion and a longer posterior glandular portion.

Male.—The tail is straight and it bears broad caudal alae, which unite behind the tip of the tail; the alae are slightly asymmetrical, that on the left side extending a little further forward than that on the right side, and their ventral surfaces are marked by transverse striations. There are nine pairs of pedunculated papillae supporting the caudal alae; four pairs of these are in front of the cloaca, one longer pair is opposite the cloaca, and four pairs, which diminish in length from before backwards lie behind the cloaca. The spicules are long, thin, and unequal; the right spicule is about twice as long as the left, and in the single male available they cross about the middle of the shorter spicule. There is a boat-shaped gubernaculum (fig. 3c).

Female.—The tail ends in a bluntly rounded tip. The vulva opens a little in front of the anus into a flask-shaped muscular ovijector, a long unpaired tube passes forwards from this structure eventually dividing into two uterine branches (fig. 3d). Both uterine branches run forwards to about the middle of the worm, at this point one branch bends backwards and ends in a coiled tubular ovary about halfway between the vulva and anus; the other uterine branch continues an anterior course and ends in an ovary about 0.8 mm. from the anterior end of the worm. Both branches of the uterus are filled with eggs containing embryos.

Measurements.

Male—

| | |
|-------------------------------|-----------|
| Length | 7.1 mm. |
| Maximum breadth | 0.2 mm. |
| Head, diameter | 0.084 mm. |
| Depth of buccal capsule | 0.08 mm. |
| Oesophagus, muscular | 0.3 mm. |
| " glandular | 1.1 mm. |
| Spicule, right | 0.694 mm. |
| " left | 0.357 mm. |

Female—

| | |
|----------------------------|--------------------------------------|
| Length | 10.75 mm. |
| Maximum breadth | 0.35 mm. |
| Diameter of head | 0.19 mm. |
| Anus to tip of tail | 0.16 mm. |
| Vulva to tip of tail | 0.59 mm. |
| Ovijector, length | 0.175 mm. |
| Unpaired trunk | 0.89 mm. |
| Eggs | 0.040–0.042 \times 0.020–0.022 mm. |

Comparison of this worm with the descriptions of the complete list of *Habronema* of birds given by Cram¹ (1927) shows that it is quite distinct from all the known species. The most striking character is the extreme posterior position of the vulva, for in the majority of the species the vulva is situated in front of or near the middle of the body ; in only three of the species viz. *H. longestriata*, *H. seurati*, and *H. unilateralis* is it found in a definitely posterior position, and in none of these is it apparently as far back as in the present instance.

Type-specimens are in the Calcutta School of Tropical Medicine.

¹ Cram, E. B. (1927). Bird Parasites of the Nematode Suborders Strongylata, Ascaridata, and Spirurata. *U. S. Nat. Mus. Bull.*, No. 140.

THYSANOPTERA FROM INDIA.

By DUDLEY MOULTON, *San Francisco, California.*

I am indebted to Dr. Hem Singh Pruthi, Assistant Superintendent, Zoological Survey of India, Indian Museum, Calcutta, for the privilege of reviewing and classifying this series of Thysanoptera from India, some of which have been in the collection of the Museum for many years, and I wish to express my appreciation to Dr. Pruthi and to those others who have made the collections in the field. This paper includes a description of two new genera and five new species, together with a record of ten species already described.

TEREBRANTIA Haliday.

Family THRIPIDAE, Uzel.

Subfamily THRIPINAE.

1. *Frankliniella sulphurea* Schmutz.

Two specimens (♀♀) collected in flowers of *Datura fastuosa* at Barkuda Island, Chilka Lake, Ganjam District, Madras Presidency, 3-X-22 (N. Annandale). (Moulton No. 1997).

Genus **Monilothrips**, gen. nov.

(*Monilae*=collar.)

Head somewhat wider than long, with a conspicuous reticulated collar-like band along the posterior margin, but anterior to this the vertex is without conspicuous lines or markings. Prothorax much wider than long, without reticulation. There are two conspicuous closely-placed spines at each anterior angle, one directed forward, the other outward and backward, and a pair at each posterior angle the outer of which is about twice as long as the inner one. Mesonotal plate with net-like reticulation in front which changes gradually to cross striations behind, metanotum distinctly reticulate. Abdomen broadly ovate with tenth segment small and conical, with net-like reticulation on all segments except the first and the last two. Antenna 8-segmented, segments 3 and 4 vase-shaped and with forked trichomes. Style with 2 segments, the second is about three times longer than the first and together they are about twice as long as segment 6. Maxillary palpus with 3 segments. Fore tarsi unarmed. Wings long and pointed, with two longitudinal veins which, though distinct, are placed near the anterior and posterior margins and at first glance would appear to be fused with the marginal veins. All wing spines unusually long, those on costa being about twice as long as width of wing, spines on longitudinal veins evenly placed over their entire length.

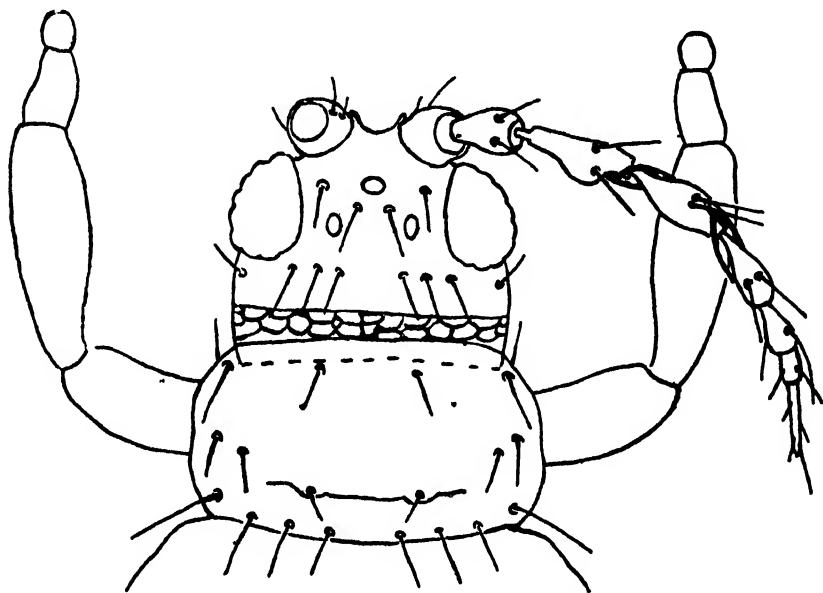
This genus would seem to be most closely related to *Ayyaria*, Karny, but is at once separated by the small sixth segment of antenna and unusually long style, also by its 3-segmented labial palpus. The chaetotaxy is much the same as in *Ayyaria*.

2. *Monilothrips kemp*i, sp. n.

Female holotype.—Colour uniformly orange brown. Antennal segments 1 to 4 and base of 5 whitish-yellow, others coloured like the body. Legs yellow with slight shading of orange brown in middle of all femora and middle and hind tibia. Wings uniformly whitish-yellow.

Total body length 1.5 mm.; head length .16 mm., width .20 mm.; prothorax length .116 mm., width .25 mm.; mesothorax width .36 mm.; abdomen width .61 mm. Antennae: length (width) i, 15 (33); ii, 45 ? (36); iii, 90 (27); iv, 78 (27); v, 60 (27); vi, 36 (24); vii, 21 (13); viii, 54; total length 390 m. Length of spines: Interocellars 30 m., postoculars 39 m., the forward directed spines of pair at anterior angles of prothorax 45 m., the posteriorly directed ones 54 m., pair along anterior margin 30 m., median lateral 36 m., pair at posterior angles, outer 84, inner 36 m., at posterior angles and margin of ninth abdominal segment 150, on tenth 90 m.

Head one-fourth wider than long and projecting in front between basal segments of antenna, this projection with a distinct concave anterior margin; cheeks slightly arched. Two spines in front of and three behind each posterior ocellus. Back of head with a distinct transverse reticulated band near posterior margin. Eyes large with coarse facets.



TEXT-FIG 1.—*Monilothrips kemp*i, gen. et sp. nov. Head and prothorax of ♀.

Ocelli small. Mouth-cone broad and strong, maxillary palpus with three segments. Antenna slender, 2.5 times as long as head, segment 1

short and broad, segments 3 and 4 vase-shaped, each conspicuously and abruptly narrowed at base of forked trichomes, 5 elongate-clavate, 6 short, style with second segment three times as long as first and together twice as long as segment 6.

Prothorax transverse, with spines as follows : a pair at each anterior angle, one of which is curved and directed forward, the second directed backward, the inner spine of the pair at posterior angle is not more than half as long as the outer one, and is of about equal length with the pair on either side along posterior margin. Prothorax without conspicuous markings or reticulations. Meso- and metanotum clearly reticulated. Legs moderately stout, fore tarsi unarmed. Wings long and strong with two longitudinal veins which are distinct but are placed close to the anterior and posterior margins. All spines unusually long and evenly placed as follows : costa 33, fore vein 16, hind vein 18. Microscopic setae covering surface of wing also unusually long.

Abdomen broadly ovate with terminal segment short and connate. Tergites two to eight inclusive clearly reticulated, second with a distinct dark brown line along anterior margin, which is placed away from the margin on segments two to eight, the surface anterior to these lines is without markings but is clearly reticulated behind them. The dark line on segment one is semi-circular in outline. The spines at the posterior angles and margin of segment 9 are long, extending far beyond the tip, those on segment 10 are short, segment 10 has a complete dorsal suture.

Type-material.—Female holotype taken from an unknown host plant on May 4, 1917 (*S. W. Kemp*). Type deposited with Indian Museum. (Moulton No. 1998). Named in honour of the collector.

Type-locality.—Sureil, Nangphu, Darjiling District, East Himalayas, elevation 5,000 feet.

3. *Taeniothrips longistylus* Karny.

Two specimens (♀♀) taken at Buldana, Berar, Central Provinces, in February, 1923 (*H. S. Rao*). Host-plant unknown. (Moulton No. 1992).

4. *Taeniothrips lefroyi* Bagnall.

One specimen (♀) taken at Sitong, Darjiling District, East Himalayas, elevation about 2,500 feet, 28-X-17 (*N. Annandale* and *F. H. Gravely*). Host-plant unknown. (Moulton No. 1994).

5. *Taeniothrips flavidulus* Bagnall.

One specimen (♀) taken on Pine trees at Phagu, Simla Hills, East Himalayas, elevation 9,000 feet, 21-X-16 (*N. Annandale* and *S. W. Kemp*). (Moulton No. 1995).

Projectothrips, gen. nov.

(*Projectus*=projection.)

With many characters of the genus *Taeniothrips*. Antennae inserted on the anterior ventral side of the head so that the first segments are

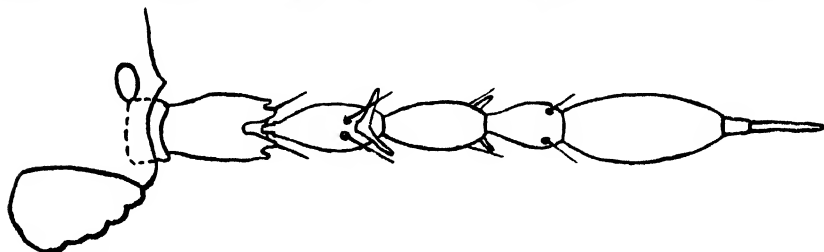
largely obscured, second segment with two blunt lobe-like projections on dorsal end at tip, each of which bears a short spine, sixth segment largest of all, elongate-ovate, style with first segment short and end segment very long and cylindrical in shape, six times as long as preceding segment. Chaetotaxy mostly as in *Taeniothrips*. Comb arrangement of spines on posterior margin of eighth abdominal segment complete, but there is a similar arrangement of spines on the posterior margin of abdominal segments beyond the second, these are present but short on the seventh segment, less conspicuous on the sixth and gradually disappear in the centre of other more anterior segments. Wings broad at the base and reduced gradually to a pointed tip. Fore vein with a broken series of spines, those on hind vein regularly placed.

6. *Projectothrips pruthi*, sp. n.

Female holotype.—Body colour uniformly orange brown, legs light yellowish-brown, wings uniformly brown, lighter at the base. Antennal segments 1 and 2 concolorous with head, 3 and 4 clear yellow, 5 to 8 uniformly light brown. Crescents of ocelli orange-red.

Total body length (specimen contracted) 83 mm.; head length .09 mm., width .15 mm.; prothorax length .15 mm., width .189 mm.; pterothorax width .24 mm.; abdomen width .31 mm. Antennae: length (width) i, 12 (30); ii, 30 (27); iii, 36 (?); iv, 36 (21); v, 30 (16); vi, 45 (24); vii, 6; viii, 36; total length 225 m. Length of spines: at posterior angles of prothorax, outer 36 m., inner 18 m., on posterior angles and margin of ninth abdominal segment 120 m., on tenth 135 m., interocellar spines 21 microns.

Head clearly transverse, roundly flattened in front; cheeks slightly arched, interocellar spines moderately short and placed in front of posterior ocelli and mid-way on a line connecting each of them with anterior ocellus. Back of head with numerous transverse wavy lines. Eyes large. Ocelli well developed. Mouth-cone short and narrow, maxillary palpus 3-segmented, labial palpus with one segment, if with two segments the first is so small that it cannot be observed. The apparent single segment is long and finger-like. Antenna arising from the anterior



TEXT-FIG. 2.—*Projectothrips pruthi*, gen. et sp. nov. Right antenna.

lower surface of the head so that the first segments are hardly visible, 2.5 times longer than head. Second antennal segment with two prominent dorsal lobes at tip, each of which bears a spine at the end, segment 5 small, segment 6 large with sides evenly rounded from the base to tip. The two segments of style are of even width but the first is

very small and the second long, approximately six times longer than the first. Forked sense-cones on segments 3 and 4 reasonably short and stout.

Prothorax slightly wider than long, without spines on anterior angles, the outer spine at the posterior angles is approximately twice as long as the inner one, a series of three on either side along posterior margin. Legs normal. Wings fully developed, broad at base, gradually narrowed to a pointed tip with two longitudinal veins. Spines as follows : costa 28, fore vein 3—10 in basal two-thirds and 1—2 at tip, hind vein 12.

Abdominal segments 1 to 8 broadly ovate, 9 and 10 triangularly connate. Normal spines on ninth and tenth segments long and strong, tenth segment with a complete dorsal suture. Comb-like arrangement of hairs on posterior margin of eighth segment complete and rather long. Posterior side margins of segments 3 to 7 also with a similar arrangement, these are wanting in the middle of the first segments but their development gradually increasing to almost a complete comb on the seventh segment.

Characters as specified of antennal segments 2 and 6 to 8 and the comb-like arrangement of spines on posterior margins of abdominal segments are so distinct that I cannot place this species within the genus *Taeniothrips*. These characters also set it apart from any species in that genus.

Type-material.—Female holotype, six ♀ paratypes taken on *Pandanus*, 1-I-22 (H. S. Rao). Holotype and five paratypes deposited in Indian Museum, Calcutta. (Moulton No. 1996). This species is named in honor of Dr. Hem Singh Pruthi of the Indian Museum.

Type-locality.—Sibpore near Calcutta, Bengal.

7. *Thrips setosus*, sp. n.

Female holotype.—Colour whitish-yellow, first antennal segment colourless, 2 shading to pale yellow, 3 pale yellow at base shading to light greyish-brown, 4 and 5 pale yellow at base shading to greyish-brown in distal half, 6 and 7 grey-brown, with 6 somewhat lighter at base. Wings almost colourless. Crescents of ocelli deep orange.

Total body length .92 mm. ; head length .075 mm., width .114 mm. ; prothorax length .105 mm., width .135 mm. ; pterothorax width .19 mm. Antennae beyond second segment : iii, 36 (16) ; iv, 33 (16) ; v, 30 (15) ; vi, 39 (15) ; vii, 9 ; total length 180 m. Length of spines : on posterior angles of prothorax 21 m., on posterior angles and margin of ninth abdominal segment 60 m. and 51 m. respectively, on tenth 60 m.

Head transverse, with numerous transverse striations ; cheeks arched, interocellar and other spines small. Eyes prominent, somewhat protruding. Ocelli small, each the size of a single eye facet. Antenna 2.4 times longer than head.

Prothorax clearly wider than long and densely covered with short (15 m.) conspicuous setae. A pair of spines at posterior angles also very short, inward from these a series of four short setae on either side. Median pair of spines on metanotum placed approximately 12 m. back from anterior margin. Legs normal. Wings fully developed, with spines

as follows : costa 31, fore vein 4-3 at base, 1 (or 2) in the middle, 2 at tip, hind vein 15.

Abdomen normal.

Type-material.—Female holotype taken from an unknown host plant, 16—20-VIII-11 (*N. Annandale* and *F. H. Gravely*). Type deposited in Indian Museum. (Moulton No. 2002).

Type-locality.—Balighai near Puri, Orissa.

This species is rather closely related to *T. pallidulus* Bagnall, but is easily separated from this species as follows : the fore wings of *pallidulus* are brownish except at base, costa of fore wings has 15—18 and hind vein 7—9 spines, and spines at posterior angles of prothorax are about .5 as long as median length of pronotum. In this new species the wings are almost colourless, wing spines more numerous and those at the posterior angles of prothorax are much shorter, not more than .25 median length of pronotum, also pronotum is densely covered with small setae.

8. *Thrips florum* Schmutz.

Four specimens (♀♀) taken at Buldana, Berar, Central Provinces, in February, 1923 (*H. S. Rao*). Host-plant unknown. (Moulton No. 1992).

9. *Selenothrips rubrocinctus* Giard.

One specimen (♀) taken on *Aporosa roxburghii* at Durgapurs, Salt Lakes, near Calcutta, Bengal, 8-III-14 (Moulton No. 2000), and six females, two males and two larvae taken in *Gardinia* flowers at Museum Compound, Calcutta, 8-VII-14 (*F. H. Gravely*). (Moulton No. 2001).

TUBULIFERA.

Family PHLOETHRIPIDAE Hood.

Subfamily PHLOETHRIPINAE Priesner.

10. *Haplothrips ceylonicus* Schmutz.

One specimen (♀) taken at Buldana, Berar, Central Provinces, February, 1923 (*H. S. Rao*). Host-plant unknown. (Moulton No. 1992).

11. *Gynaikothrips flaviantennatus*, sp. n.

Female holotype.—Colour deep chestnut brown. Antennal segments 1 and 2 concolorous with head, 2 shading lighter toward the tip, 3 to 8 uniformly clear yellow. All femora, middle and hind tibia dark brown, fore tibia light yellowish-brown shading to clear yellow at tip, all tarsi clear yellow. Prominent body spines brown. Fore wings light grey-brown with a darker streak in the center, hind wings almost clear but with a darker median line.

Total body length 2.25 mm. ; head length .28 mm., width .19 mm. ; prothorax length .183 mm., width including coxae .36 mm. ; pterothorax width .40 mm. ; tube length .20 mm., width at base .083 mm. Antennae : length (width) i, 36 (42) ; ii, 57 (33) ; iii, 69 (33) ; iv, 69 (36) ; v, 69 (33) ; vi, 72 (30) ; vii, 51 (27) ; viii, 33 ; total length 465 m. Length of spines :

postoculars 78 m., median dorsal inward from postoculars 21 m., on anterior angles of prothorax 57 m., anterior margin 45 m., mid-laterals 31 m., pair on posterior angles subequal, 120 m., on ninth abdominal segment 155 m., at tip of tube 165 m.

Head 1.5 times longer than wide ; cheeks straight and almost parallel with a constriction at the base which is hardly noticeable. Back of head with numerous closely placed wavy lines. Postocular spines long and strong with dilated tips. Eyes normal with small facets. Ocelli large. Mouth-cone short and broadly rounded at the tip. Antenna 1.65 times longer than head, intermediate segments elongate clavate.

Prothorax, including coxae, twice as long as median dorsal length of pronotum and .66 as long as head. All normal spines strong and with dilated tips. Pterothorax subquadrate. Fore femora somewhat enlarged, each fore tibia armed with a stout broad-seated tooth. Wings fully developed, with 7—8 double fringe hairs along posterior margin, 3 basal wing spines arranged in a straight line along anterior margin, stout with dilated tips.

Abdomen with all normal spines strongly developed, dark brown in colour except only those on segment 9 and tube which are yellowish.

Male allotype.—Shaped and coloured like the female but smaller in size, 1.63 mm., and with spines at posterior angles of ninth abdominal segment reduced to spurs which are 45 m. long.

Type-material.—Female holotype, male allotype and 13 female paratypes taken from an unknown host plant, 16—20-VIII-11 (*N. Annandale* and *F. H. Gravely*). Holotype, allotype and 9 paratypes deposited in Indian Museum, Calcutta. (Moulton No. 2002).

Type-locality.—Balighai, near Puri, Orissa.

This species would seem to approach *G. heptapleuri* Karny from Java, but is distinguished from it by the clearly shorter tube.

12. *Gynaikothrips flavitibia*, sp. n.

Female holotype.—Colour orange brown, including all femora, first antennal segment and basal half of second. All tibia, tarsi and antennal segments 2 to 8 clear yellow. Wings transparent. Prominent body spines clear to yellowish.

Total body length 2.5 mm. ; head length .28 mm., width .25 mm. ; prothorax length .19 mm., width including coxae .38 mm. ; pterothorax width .43 mm. ; tube length .31 mm., width at base .08 mm. Antennae : length (width) i, 30 (36) ; ii, 51 (34) ; iii, 78 (30) ; iv, 75 (36) ; v, 75 (33) ; vi, 78 (31) ; vii, 60 (24) ; viii, 39 ; total length 495 microns. Length of spines : postoculars 54 m., a second pair inward from these and in almost a straight line between them 66 m. On anterior angles of prothorax and anterior margins 54—60 m., mid-laterals 60, pair on posterior angle, outer 114, inner 84 m., on ninth abdominal segment 280—300 m., at tip of tube 240 m.

Head subquadrate, 1.2 times longer than wide ; cheeks straight and parallel. Frons arched and bearing forward directed anterior ocellus at tip. Back of head sculptured with numerous wavy confluent lines. Eyes large with small facets. Ocelli well developed, fully three times larger than facets of eyes. Postocular spines well developed, with

dilated tips and a second pair of similar spines but somewhat longer are placed in an almost straight line between the postoculars, all four are separated by equal distances. Mouth-cone broadly rounded, labrum more or less angular and pointed. Antenna 1.75 longer than head, moderately slender.

Prothorax transverse, pronotum sculptured like the back of the head. All normal spines well developed and with dilated tips. Pterothorax with even sides, slightly converging towards the posterior. Legs normal, each fore tarsus armed with a broad seated tooth. Wings normal, with 15 double fringe hairs along posterior margin. Abdomen long and slender, reduced gradually from second to eighth segment. Tube slender, almost four times longer than width at base and about 1.1 times longer than head. Spines on ninth abdominal segment almost as long as tube.

Male allotype.—Coloured as in the female but somewhat lighter, shaped as in the female but with the abdominal segments reduced more gradually toward the end. Fore tarsi armed as in female. Total body length 2.2 mm.; head length .25 mm., width .21 mm.; tube length .25 mm. Spines on posterior angles of ninth abdominal segment greatly reduced, only 30 m. long as compared with those along the posterior margin which are 225 m.

Type-material.—Female holotype, male allotype, nine female and six male paratypes collected 8-VIII-14 (*E. Rose*). Holotype, allotype and paratypes deposited with Indian Museum. (Moulton No. 2004).

Type-locality.—Calcutta, Bengal.

This species can be compared with *G. interlocatus* Karny from India, but is easily separated from that species which has the terminal antennal segments brown, postocular spines short and black and fore tarsi unarmed. This species also resembles *G. uzeli* Zimmermann somewhat closely, but is easily distinguished from it by the clear colour of the middle and hind tibia and the chaetotaxy of the prothorax.

13. *Gynaikothrips uzeli* Zimmermann.

Six female and two male specimens taken on leaves of *Ficus obtusa* on Barkuda Island, Chilka Lake, Ganjam District, Madras Presidency, 3-X-22 (*N. Annandale*). (Moulton No. 2003).

14. *Gigantothrips elegans* Zimmermann.

Numerous specimens (♂♂, ♀♀, larva) taken on *Ficus glomarata* at Pusa, Bihar, 5—10-XI-15 (*F. H. Gravely*). (Moulton No. 1999). One specimen (♀) taken on leaves of *Ficus obtusa* on Barkuda Island, Chilka Lake, Ganjam District, Madras Presidency, 3-X-22 (*N. Annandale*). (Moulton No. 2003).

Subfamily MEGATHRIPINAE.

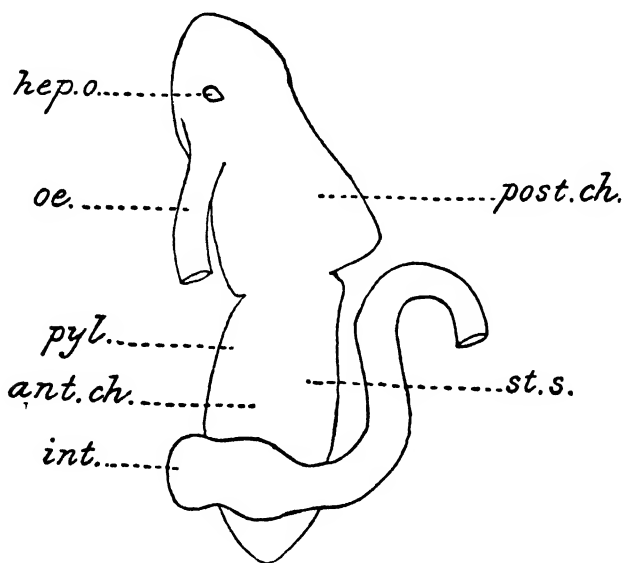
15. *Dinothrips sumatrensis* Bagnall.

Twelve specimens, (eight ♀♀, one ♂ and three larvae) taken at Port Blair, Andaman Islands, 15-II—III-15 (*S. W. Kemp*). Host-plant unknown. (Moulton No. 1993).

THE STYLE-SAC OF SOME FRESHWATER GASTROPODS.

By R. V. SESHAIYA, M.A., *Mahant's High School,*
Tirupati, South India.

In a recent paper (6) I showed that the stomach of *Paludomus* is interesting owing to the possession of a much restricted communication between the style-sac and the pyloric part of the stomach. The present note deals with the style-sacs of *Melanoides*, *Mysorella* and *Amnicola* (*Alocinma*). A comprehensive account of the style-sacs of Gastropods was published by Robson (5) and Mackintosh (2), but none of the genera which form the subject of this note are mentioned by them. Even in the closely allied genera *Bithynia* and *Melania*, which are known to possess a style-sac, the relation of the style-sac to the intestine has not been properly investigated. *Melania* is said to possess a style-sac completely separated from the intestine, but from my observations on the stomach of *Melanoides* and *Paludomus* I am of opinion that the stomach of *Melania* needs reinvestigation. In *Bithynia* nothing is known except that a style-sac is present.



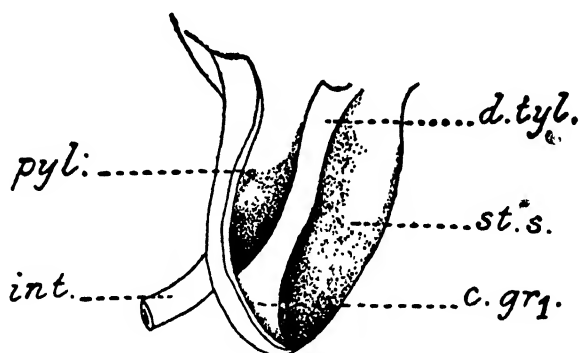
Text-fig. 1.—Stomach of *Mysorella* as seen from the ventral side.

ant. ch., anterior chamber; *hep. o.*, opening of the hepatopancreatic duct; *int.*, intestine; *oe.*, oesophagus; *post. ch.*, posterior chamber; *pyl.*, pylorus; *st. s.*, style-sac.

The style-sac of *Melanoides* bears a close resemblance to that of *Paludomus* in its disposition, structure, and relationship to the intestine. Externally the style-sac appears to be independent of the intestine, but a closer examination of the junction of the style-sac with the stomach proper shows a distinct, though short, communication between

the style-sac and the short pylorus by means of a transverse slit measuring about 0.65 mm. long and about 0.05 mm. wide. It would, therefore, be incorrect to state that the style-sac and the pyloric element of the stomach are quite distinct in a form like *Melanoides*. The slit-like connection between the pylorus and the style-sac extends for a distance of 0.14 mm. in a medium sized individual in which the style-sac has a cavity about 1.85 mm. long.

As in the case of *Paludomus* the slit-like communication between the pylorus and the style-sac is continued as a longitudinal ciliated groove on the left or the pyloric side of the style-sac, while at its anterior end the style-sac has a circular termination, in which the crystalline style appears to be held. The longitudinal ciliated groove is wider than in *Paludomus* and its diameter is not uniform throughout its course. The cells lining the ciliated groove are shorter than those of the style-sac epithelium. On the sides of the groove the cells have well developed cilia, while those at the bottom of the groove show sparse ciliation and are sometimes without any cilia. Where the style-sac epithelium becomes continuous with that of the right side of the ciliated groove the cells are narrow, long and crowded together. The style-sac epithelium shows the usual structure. The cilia form an uniform coating on the cells of sac and are about one-third the length of the cells. The nuclei are large and rounded and are situated about the middle. The cytoplasm near the free ends of the cells possesses a greenish-brown pigment. In general features the style also resembles that of *Paludomus*.

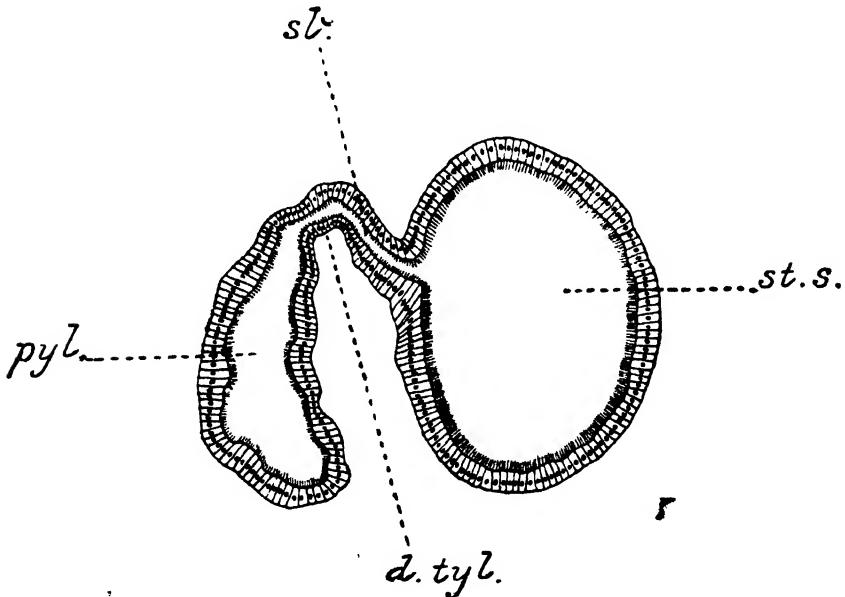


Text-fig. 2.—Anterior chamber of the stomach of *Mysorella* with the ventral wall removed.

c. gr., portion of the anterior chamber which appears as the ciliated groove in section; d. tyl., typhlosole of the dorsal wall between the pylorus and style-sac; int., intestine; pyl., pylorus; st. s., style-sac.

The style-sac of *Mysorella* differs from that of *Melanoides*, and resembles more that of *Hypsobia* and *Paludestrina* as described by Robson (3, 4). The stomach of *Mysorella*, like that of forms with a style, is divisible into an anterior and a posterior portion, the latter constituting the gastric portion. On opening the anterior portion of the stomach of *Mysorella*, two cavities are noticed, a right tubular cavity which is the style-sac, and a shorter, narrower, obliquely-disposed cavity on the left, which is the pylorus. The pylorus at a distance of about two-thirds the length of the anterior portion of the stomach passes into the

intestine. Throughout its length, about 1.21 mm., the pylorus communicates with the style-sac by a longitudinal slit, which is about 0.34 mm. by 0.03 mm. In transverse sections of the anterior chamber, anterior to the origin of the intestine from the pylorus, the style-sac has a groove on the pyloric side. Robson (4) has recorded a groove in *Paludestrina*, but he does not make any definite mention about the portion of the style-sac which exhibits this groove on the pyloric side. Judging from what I have observed in *Mysorella*, the groove in *Paludestrina* also must be anterior to the termination of the pyloric chamber. Serial sections and a careful dissection of the anterior chamber show that after the pylorus gives rise to the intestine the slit-like communication between the style-sac and the pylorus is continued to the free end of the anterior chamber and appears as the groove of the style-sac. The groove, thus, has essentially the same structure, and arises in the same way as in *Palu-*



Text-fig. 3.—Transverse section from the middle of the anterior chamber of the stomach of *Mysorella* showing the relations of the style-sac to the pylorus.

d. tyl., typhlosole of the dorsal wall between the pylorus and style-sac; *pyl.*, pylorus; *sl.*, slit of communication between style-sac and pylorus; *st. s.*, style-sac.

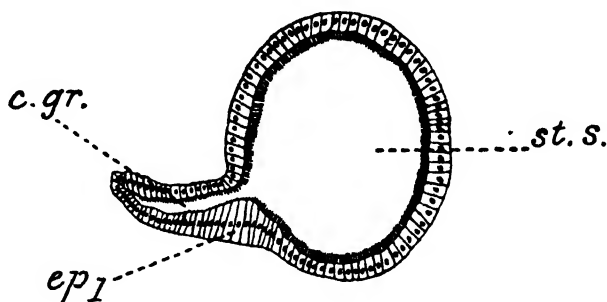
domus and *Melanoides*, and the difference lies in the much longer pyloric connection and a consequently short groove. The following measurements will give an idea of the different portions of the pylorus, style-sac, etc. of *Mysorella* :—

| | |
|--|--|
| Length of style-sac | 1.47 mm. |
| Total length of the pyloric chamber | 1.21 mm. |
| Origin of the intestine | Extending from 0.89 mm. to 1.21 mm. of the pylorus. |
| Portion of the style-sac anterior to the termination of the pylorus and showing the ciliated groove | 0.26 mm. |

The cavity of the style-sac is roughly tubular, though somewhat flattened laterally. In transverse section it is 0.46 mm. by 0.41 mm. The pyloric cavity is narrower and is much compressed. In transverse section it is 0.45 mm. by 0.17 mm. The ciliation and the epithelium of the style-sac present the usual features, and do not call for any further remarks. No pigment was detected in the cytoplasm of the cells. The pyloric epithelium is also ciliated but the cilia do not form an even coating as in the case of the cells of the style-sac. The cells lining the right and left sides of the slit are also ciliated. In the groove the cells on the right side are long, narrow and crowded, and show very few cilia. The style is cylindrical and longer than the style-sac.

The style-sac of *Amnicola* (*Alocinma*) is similar to that of *Mysorella* and needs no special description.

A comparison of the style-sacs of *Paludomus*, *Melanoides*, *Mysorella* and *Amnicola* clearly indicates the morphological significance of the longitudinal groove of the style-sac, as I have discussed at length in my paper on the stomach of *Paludomus* (6). A comparison of these forms with Lamellibranchs like *Mya* shows that the groove in the two groups, Gastropods and Lamellibranchs, is homologous.



Text-fig. 4.—Transverse section of the anterior chamber of the stomach of *Mysorella* anterior to the termination of the pylorus.

c. gr., ciliated groove; *ep1*, long cells on the right side of the ciliated groove; *st. s.*, style-sac.

It has been suggested by Ghosh (1) that the style-sac might have evolved as an outgrowth of the stomach and that the course of evolution might be from an original separation to union between the pylorus and the style-sac in the more highly evolved forms. The structure of the style-sacs in the forms mentioned above does not lend any support to this view, as it does not offer any satisfactory explanation for the longitudinal ciliated groove, whose nature as a vestige of a former pyloric connection is so clearly indicated in *Mysorella* by its presence on the pyloric side of the sac, anterior to the termination of the pylorus and in continuation of the pyloric communication of the style-sac.

In conclusion I have to acknowledge my great indebtedness to Dr. Baini Prashad for encouragement and for the interest he has taken in the progress of my work.

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ON A COLLECTION OF INDIAN PALPATORES (PHALANGIIDÆ)
WITH A REVISION OF THE CONTINENTAL GENERA AND
SPECIES OF THE SUB-FAMILY GAGRELLINAE THORELL.

By C. FR. ROEWER, *Bremen.*

In 1924 I received for identification a large collection of Opilionids or Phalangids, consisting of roughly a thousand specimens, from the Zoological Survey of India, Indian Museum, Calcutta, through Dr. Baini Prashad. About 50 specimens of this collection, which belonged to the suborder Laniatores, have already been dealt with by me in a paper¹ on the African, Malayan and Australian species of the suborder from the collections of the late Dr. E. Simon of the Museum d'Histoire Naturelle, Paris, Professor K. Dammerman of Buitenzorg, the late Dr. Fuller Baker of Los Banos, Philippines and the late Mr. L. Fea of the Museo Civico di Storia Naturale, Genova. This paper deals with the remainder of the collection consisting of forms belonging to the suborder Palpatores. In this communication I have also included an account of a collection of about 130 Opilionids, which were sent to me for determination by Dr. F. H. Gravely, Superintendent of the Government Museum, Madras; about 20 specimens in this collection belonged to the suborder Laniatores and have been included in the paper cited above. I take this opportunity of tendering my best thanks to Dr. Baini Prashad and Dr. F. H. Gravely for sending me these rich collections for study.

The collections sent to me for determination were mostly made by Dr. F. H. Gravely and Dr. S. W. Kemp, while a few specimens were also collected by the late Lord Carmichael, Mr. E. Barnes and Mr. R. H. Hodgart. The greater part of the collection consists of specimens from the Darjeeling District, Eastern Himalayas, Palni Hills and Cochin State, Southern India, while a few specimens are from the Satara District, Bombay Presidency; Portuguese India; Bihar and Orissa, Courtallam, Nilgiris, Madras Presidency; Nepal; Ceylon; Paulo Penang and Singapore.

In connection with the Laniatores of the two collections, which have already been dealt with in the paper cited above, it is of interest to note that practically all the specimens, leaving out of consideration the forms of the genus *Pelitus* of the family Oncopodidae from Paulo Penang, belong to the families Phalangodidae and Assamiidae, both of which have a wide distribution in the Indo-Malay Region.

The Palpatores of the collections, which are dealt with in the following pages, contained four immature² specimens from the Kashmir Valley, Central Gilgit and Mount Godwin-Austen, all in the upper regions of the Himalayas. These specimens unfortunately cannot be definitely

¹ Roewer, C. Fr.—*Weitere Weberknechte I., I Ergänzung der "Weberknechte der Erde"* (Jena, 1923) in *Abhandl. Nat. Ver. Bremen*, XXVI, pp. 261—402, pl. i (1927).

² Following the terminology suggested by me in my Monograph, *Die Weberknechte der Erde*, p. 39 (Jena, 1923), I refer to the immature forms as *pulli* in the following pages.

identified, but they appear to belong to the Palaearctic types of Phalanginae, and may represent the furthestmost extensions of the Palaearctic forms into the Indian area. The question, however, cannot be definitely settled till further collections of full-grown adults are available.

The working out of the rich collections from the Indian area has induced me to bring together in this paper all the information about the various genera and species of the sub-family Gaggrellinae, but I have not included the insular species in this account.

For the separation of the different genera of the sub-family Gaggrellinae I have employed the same characters as the ones used by me in my Monograph, cited already. I attach special importance to the number and the distribution of the noduli on the femora of the four legs. These noduli, as I am able to state with confidence from my examination of thousands of specimens, are found on the femora of the Gaggrellinae only. The numbers and distribution of the noduli, further, are almost always constant in the different species, as I have found on examination of hundreds of specimens of the same species; and from the present collections alone one may cite as examples *Gaggrella parva*, *Aurivilliola shanica*, *Strandina aurantiaca*, *Zalpetus sulphureus*, *Ceratobunus annulatus*, etc. During my work on the Gaggrellinae, which has extended over many years, I have only in very exceptional cases found any deviation from the normal number of noduli, and I have, therefore, employed the numbers and distribution of the noduli as distinguishing characters for the separation of the different genera of this sub-family. If these characters and the sculpture and granulation of the scutum and the ocular tubercle are not taken into consideration, as With¹ suggested, it will not be possible to divide into genera several hundreds of species, all of which will have to be included in the genus *Gaggrella* Stoliczka.

For the genera and species already known I have given references only to the original diagnoses and to the account in my recent Monograph, cited already; the remaining references to the literature on these forms will be found in my Monograph. The species represented in the present collections are marked with an asterisk.

Subfamily GAGGRELLINAE Thor.

1889. Gaggrellinae, Thorell, *Ann. Civ. Stor. Nat. Genova*, XXVII, p. 521.

1923. Gaggrellinae, Roewer, *Weberknechte der Erde*, p. 924.

Key to the subfamily Gaggrellinae.

- | | |
|---|----|
| 1. Scutum medially armed with one or more blunt humps or spines | 2 |
| Scutum entirely smooth, unarmed | 37 |
| 2. Scutum medially armed with a longitudinal row of 3—5 spines or blunt humps | 3 |
| Scutum medially armed with one (seldom two) spine or hump or column | 6 |
| 3. Scutum with a median longitudinal row of 3—5 spines | 4 |
| Scutum with a median longitudinal row of 5 blunt humps; number of noduli on 1st to 4th femora 0-2-0-0 | |

Hehoa, p. 111.

¹ With, —*Journ. Linn. Soc., London*, Zool. XXVIII, pp. 465—509 (1903).

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| 4. Scutum with a median longitudinal row of 5 spines; number of noduli on 1st to 4th femora 0-1-0-0 | <i>Systenocentrus</i> , p. 112. | |
| Scutum with a median longitudinal row of 3-4 spines | | 5 |
| 5. Ocular tubercle toothed basally under the eyes | <i>Salaria</i> , p. 112. | |
| Ocular tubercle unarmed basally | <i>Syleus</i> , p. 114. | |
| 6. Number of noduli on 1st to 4th femora 0-1-0-0 | | 7 |
| Number of noduli on 1st to 4th femora different | | 15 |
| 7. 2nd femur clavate | <i>Akalpia</i> , p. 114. | |
| 2nd femur not clavate, thin | | 8 |
| 8. Ocular tubercle smooth or granulated, without large spines | | 9 |
| Ocular tubercle with large spines or humps | | 13 |
| 9. Scutum armed with one or two median spines | | 10 |
| Scutum armed with one blunt hump or thick column | | 11 |
| 10. 1st femur shorter or as long as the body, 2nd femur not twice the length of the body | <i>Melanopa</i> , p. 114. | |
| 1st femur $1\frac{1}{2}$ times longer than the body or even longer, 2nd femur more than double the length of the body | <i>Gagrella</i> , p. 117. | |
| 11. 1st area of the scutum with a blunt median hump; 1st to 4th femora shorter than the body | <i>Scotomenia</i> , p. 127. | |
| 2nd area of the scutum with one thick, blunt or pointed median cone or column or one small and low blunt hump | | 12 |
| 12. 2nd area of the scutum with one thick, blunt or pointed median cone or column | <i>Marthana</i> , p. 127. | |
| 2nd area of the scutum with one small and low, blunt hump | <i>Palniella</i> , p. 128. | |
| 13. Scutum with two median spines on 1st and 2nd areas | <i>Dentobunus</i> , p. 128. | |
| Scutum with one median spine on the 2nd area only | | 14 |
| 14. Ocular tubercle as long as broad and high (Island of Hainan) | <i>(Prodentobunus)</i> . | |
| Ocular tubercle as long as broad, but twice as high as broad. (Formosa and Philippines) | <i>(Allobunus)</i> . | |
| 15. Number of noduli on 1st to 4th femora 0-2-0-0 | | 16 |
| Number of noduli on 1st to 4th femora different | | 18 |
| 16. Ocular tubercle smooth or granulated, but without large spines | | 17 |
| Ocular tubercle above with two anterior spines (Formosa) | <i>(Metadentobunus)</i> . | |
| 17. 1st femur shorter or as long as the body, 2nd femur not twice the length of the body | <i>Melanopula</i> , p. 130. | |
| 1st femur $1\frac{1}{2}$ times longer, or even still longer, than the body, 2nd femur more than twice the length of the body | <i>Metagagrella</i> , p. 131 | |
| 18. 2nd femur with 3 noduli | | 19 |
| 2nd femur with more than 3 noduli | | 27 |
| 19. Number of noduli on 1st to 4th femora 0-3-0-0 | | 20 |
| Number of noduli on 1st to 4th femora 0-3-0-1 or 1-3-1-1 | | 24 |
| 20. Ocular tubercle toothed basally under the eyes | <i>Strandia</i> , p. 132. | |
| Ocular tubercle not armed with teeth basally under the eyes | | 21 |
| 21. Scutum armed with one thick triangular projection, which is one or two pointed at the apex | | 22 |
| Scutum armed with one or two slender spines | | 23 |
| 22. Scutum armed with one thick and large hump, bearing two median spines (Borneo) | <i>(Eumarthana)</i> . | |
| Scutum armed with one basally very thick, but apically pointed cone | <i>Crassicippus</i> , p. 135. | |
| 23. 1st femur shorter or as long as the body, 2nd femur not twice the length of the body | <i>Aurivilliola</i> , p. 136. | |
| 1st femur $1\frac{1}{2}$ times longer, or even still longer than the body, 2nd femur more than twice the length of the body | <i>Gagrellula</i> , p. 138 | |

| | |
|--|-----------------------------------|
| 24. Number of noduli on 1st to 4th femora 0-3-0-1 .. | 25 |
| Number of noduli on 1st to 4th femora 1-3-1-1 .. | 27 |
| 25. Ocular tubercle above with two anteriorly placed, finely toothed humps .. | <i>Paradentobunus</i> , p. 141. |
| Ocular tubercle smooth or toothed, but without large humps or spines .. | 26 |
| 26. Scutum with one thick, pointed cone or one column rounded at the apex .. | <i>Marthanella</i> , p. 141. |
| Scutum with one slender median spine (Sumatra) .. | (<i>Paragagrella</i>). |
| 27. Scutum with one thick but pointed cone (Sumatra) .. | (<i>Metamarthana</i>). |
| Scutum with one high and bluntly rounded column (Palawan Islands) .. | (<i>Heteromarthana</i>). |
| 28. 2nd femur with 4 noduli .. | 29 |
| 2nd femur with more than 4 noduli .. | 32 |
| 29. Number of noduli on 1st to 4th femora 0-4-0-0 .. | <i>Eugagrella</i> , p. 141. |
| Number of noduli on 1st to 4th femora 1-4-1-1 or 1-4-1-2 .. | 30 |
| 30. Number of noduli on 1st to 4th femora 1-4-1-1 .. | 31 |
| Number of noduli on 1st to 4th femora 1-4-1-2 .. | <i>Neogagrella</i> , p. 143. |
| 31. Ocular tubercle without large spines .. | <i>Gagrellenna</i> , p. 144. |
| Ocular tubercle with two anteriorly placed large spines .. | <i>Coonoora</i> , p. 145. |
| 32. 2nd femur with 5 noduli .. | 33 |
| 2nd femur with more than 5 noduli .. | 35 |
| 33. Number of noduli on 1st to 4th femora 0-5-0-0 .. | <i>Hologagrella</i> , p. 146. |
| Number of noduli on 1st to 4th femora 0-5-0-1 or 2-5-1-2 .. | 34 |
| 34. Number of noduli on 1st to 4th femora 0-5-0-1 (Celebes) .. | (<i>Sarasinia</i>). |
| Number of noduli on 1st to 4th femora 2-5-1-2 (Celebes) .. | (<i>Bonthainia</i>). |
| 35. Number of noduli on 1st to 4th femora 0-6-0-1 or 1-6-1-3 .. | 36 |
| Number of noduli on 1st to 4th femora 2-7-2-3 .. | <i>Nilgirisia</i> , p. 146. |
| 36. Number of noduli on 1st to 4th femora 0-6-0-1 (Celebes) .. | (<i>Gagrellina</i>). |
| Number of noduli on 1st to 4th femora 1-6-1-3 (Celebes) .. | (<i>Syngagrella</i>). |
| 37. Number of noduli on 1st to 4th femora 0-1-0-0 .. | 38 |
| Number of noduli on 1st to 4th femora different .. | 41 |
| 38. Ocular tubercle smooth or toothed, but without larger thorns or spines .. | <i>Zaleptus</i> , p. 147 |
| Ocular tubercle armed with large thorns or spines .. | 39 |
| 39. Ocular tubercle twice as high as long, armed with several spines in front, above and behind. (Java) .. | (<i>Echinobunus</i>). |
| Ocular tubercle above with an anterior and a posterior pair of spines .. | 40 |
| 40. 1st femur shorter or as long as the body, 2nd femur not double the length of the body .. | <i>Ceratobunellus</i> , p. 150. |
| 1st femur $1\frac{1}{2}$ —3 times longer than the body, 2nd femur more than 5 times longer than the body. (Sumatra) .. | (<i>Ceratobunoides</i>). |
| 41. Number of noduli on 1st to 4th femora 0-2-0-0 .. | 42 |
| Number of noduli on 1st to 4th femora different .. | 46 |
| 42. Ocular tubercle smooth or toothed, but without large spines .. | 43 |
| Ocular tubercle armed with large spines .. | 44 |
| 43. Ocular tubercle smooth or granulated .. | <i>Verpulus</i> , p. 150. |
| Ocular tubercle on each side of the longitudinal furrow with a row of small teeth or toothed around each eye .. | <i>Hypsibunus</i> , p. 151. |
| 44. Ocular tubercle above with an anterior and a posterior pair of spines .. | <i>Tetraceratobunus</i> , p. 151. |
| Ocular tubercle above only with two large spines .. | 45 |

| | | |
|--|--------------------------------|----|
| 45. Ocular tubercle above with two divergent spines in a median row | <i>Euceratobunus</i> , p. 151. | |
| Ocular tubercle above with two large spines situated next to the longitudinal furrow | <i>Kempina</i> , p. 151. | |
| 46. Number of noduli on 1st to 4th femora 0-3-0-0 or 0-3-0-1 | | 47 |
| Number of noduli on 1st to 4th femora different.. | | 49 |
| 47. Number of noduli on 1st to 4th femora 0-3-0-0 .. | | 48 |
| Number of noduli on 1st to 4th femora 0-3-0-1 .. | <i>Euzaleptus</i> , p. 152. | |
| 48. Ocular tubercle smooth or granulated, but without large spines | <i>Zaleptanus</i> , p. 153. | |
| Ocular tubercle above with an anterior and a posterior pair of large spines | <i>Cervibunus</i> , p. 154. | |
| 49. 2nd femur with 4 noduli | | 50 |
| 2nd femur with more than 4 noduli | | 52 |
| 50. Number of noduli on 1st to 4th femora 0-4-0-0 .. | <i>Mctazaleptus</i> , p. 155. | |
| Number of noduli on 1st to 4th femora 0-4-0-1 or 1-4-1-1 | | 51 |
| 51. Number of noduli on 1st to 4th femora 0-4-0-1 .. | <i>Metaverpulus</i> , p. 155. | |
| Number of noduli on 1st to 4th femora 1-4-1-1 .. | <i>Harmanda</i> , p. 156. | |
| 52. 2nd femur with 6 noduli | | 53 |
| 2nd femur with 7 noduli, number of noduli on 1st to 4th femora 1-7-1-2 | <i>Carmichaelus</i> , p. 157. | |
| 53. Number of noduli on 1st to 4th femora 0-6-0-0 .. | <i>Ceratobunus</i> , p. 153. | |
| Number of noduli on 1st to 4th femora 0-6-0-1 or 1-6-1-1 | | 54 |
| 54. Number of noduli on 1st to 4th femora 0-6-0-1 .. | <i>Bastia</i> , p. 159. | |
| Number of noduli on 1st to 4th femora 1-6-1-1 (Philippines) | <i>(Bullobunus)</i> . | |

Hehoa gen. nov.

Ocular tubercle as long as broad, as high, without large thorns or teeth. Scutum on 1st to 5th area with a median longitudinal row of five low and blunt humps (fig. 1). Legs rather short; 1st femur much shorter than body; 2nd femur at most as long as body; number of noduli on 1st to 4th femora 0-2-0-0.

This genus is allied to *Syleus*, but the armature of the scutum is different.

*** Hehoa bunigera, sp. nov.**

(Fig. 1).

Length of body 6, 1st to 4th femora 3, 4.5, 3.5, 4, 1st to 4th legs 13, 20, 14, 17 mm.

Surface of carapace, scutum and free tergites of the abdomen uniformly and very coarsely granulated; scutum with a median longitudinal row of five equally polished and blunt humps (fig. 1). Ocular tubercle

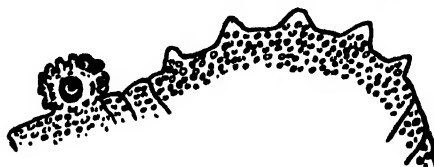


FIG. 1.—*Hehoa bunigera*, gen. et sp. nov.—Left lateral view of the dorsum of the body.

throughout, also along the area beneath the eyes, covered with still coarser granules. Free sternites of abdomen shagreened; surface of

1st to 4th coxae densely and coarsely granulated ; edge of small humps of marginal rows of coxae straightly blunted. First article of chelicerae dorsally granulated. Palps : femur ventrally denticulated, dorsally only granulated, patella without an inner apophysis and with tibia dorsally granulated, length of tibia double its diameter ; tarsus of male with a ventral longitudinal row of small granules. Legs rather short ; 1st to 4th femora granulated in longitudinal rows ; number of the noduli on 1st to 4th femora 0-2-0-0.

Colour of the whole body, of chelicerae, palps and legs ferruginous-brown ; surface of the carapace covered with white secretions of skin on the frontal border.

Locality.—S. Shan States : Heho River, Yawngnaw State (ca. 3,500 feet), 1 male, 1 female collected by Dr. F. H. Gravely.

Type-specimens.—No. $\frac{1033}{18}$ in the Zoological Survey of India (Indian Museum), Calcutta.

Systemocentrus Simon.

1886. *Systemocentrus*, Simon, *Act. Soc. Linn. Bordeaux*, XL, p. 164.

1923. *Systemocentrus*, Roewer, *Weberknechte der Erde*, p. 928.

Only two of the four known species belong to the Indian fauna.

Key to the Indian species of the genus *Systemocentrus*.

- Length of the body 6 mm. ; chelicerae and 2nd tibia uniformly black. (Siam and Burma) .. *S. quinquedentatus*.
 Length of the body 2—3 mm. ; chelicerae pale, 2nd tibia apically with a broad white ring. (Burma) *S. galeatus*.

Systemocentrus quinquedentatus Simon.

1886. *Systemocentrus quinquedentatus*, Simon, *Act. Soc. Linn. Bordeaux*, XL, p. 164.

1923. *Systemocentrus quinquedentatus*, Roewer, *Weberknechte der Erde*, p. 929.

Distribution.—Kanbuni, Siam ; Myawadi, Amherst District, Burma.

Systemocentrus galeatus (Thorell).

1889. *Uncobunus galeatus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 667.

1923. *Systemocentrus galeatus*, Roewer, *Weberknechte der Erde*, p. 929.

Distribution.—Schwegu, Upper Burma.

Sataria Rwr.

1914. *Sataria*, Roewer, *Arch. Naturg.* LXXX, fasc. 9, p. 107.

1923. *Sataria*, Roewer, *Weberknechte der Erde*, p. 930.

Only three species of this genus are found in Western Deccan. These can be distinguished by the help of the following key :—

1. 1st and 2nd thoracic tergites, each with one small median thorn *S. maculata*.
 1st and 2nd thoracic tergites unarmed

2. Body uniformly black-brown, ocular tubercle on each side above with 3 small thorns but without a median thorn *S. unicolor.*
 Body ferruginous, mottled paler; ocular tubercle above with 3 long thorns arranged in a triangle (fig. 2) *S. coronata.*

***Sataria unicolor* Rwr.**

1914. *Sataria unicolor*, Roewer, *Arch. Naturg.* LXXX, fasc. 9, p. 109.

1923. *Sataria unicolor*, Roewer, *Weberknechte der Erde*, p. 931.

Distribution.—Helvak, Koyna Hills, Satara-District; Deccan.

*** *Sataria maculata* Rwr.**

1914. *Sataria maculata*, Roewer, *Arch. Naturg.* LXXX, fasc. 9, p. 108, fig. 1.

1923. *Sataria maculata*, Roewer, *Weberknechte der Erde*, p. 930, fig. 1073.

Distribution.—Khandala, 2,500 feet, Bombay District; 1 female, N. Annandale leg., Zoological Survey of India (Ind. Mus.), Calcutta.

*** *Sataria coronata*, sp. nov.**

(Fig. 2).

Length of body 3, 1st to 4th femora 3, 7, 5, 6, 1st to 4th legs 15, 31, 14, 21 mm.

Surface of carapace, scutum and free tergites of abdomen coarsely and densely granulated; ocular tubercle in front and behind and also basally covered with fine teeth and above with three long thorns arranged in a triangle (fig. 2); 1st to 4th areas of scutum with a longitudinal row of four long and recurved spines (fig. 2). Surface of free sternites of abdomen almost smooth, of coxae densely granulated; edge of the small

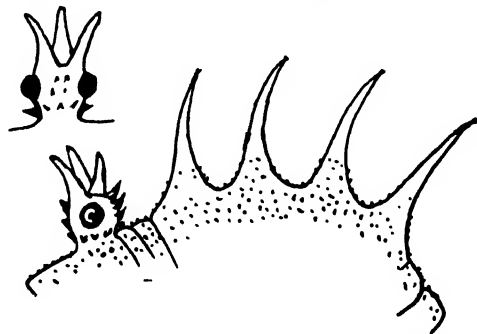


FIG. 2.—*Sataria coronata*, sp. nov. —Left lateral view of the body and frontal view of ocular tubercle.

humps of marginal rows with a very small point in the middle. First article of chelicerae dorsally granulated. Palps: trochanter, femur, patella and tibia densely and acutely granulated all round, patella apically with a densely toothed apophysis; tibia $2\frac{1}{2}$ times longer than its diameter. Legs from trochanter to tibia spaceously and finely covered with small teeth; number of noduli on 1st to 4th femora 0-1-0-0.

Colour of the body reddish-brown dorsally; carapace, scutum and free abdominal tergites mottled with lighter yellow spots; free sternites of abdomen and coxae spaceously covered with white secretions of skin. Chelicerae, palps and legs yellowish-brown.

Distribution.—Western Ghats, along the tramway, Cochin State (1 male—Gravelly leg.); Panchgani, Satara District, Bombay Presidency (1 male, 1 female—Government Museum, Madras).

Type-specimen.—No. $\frac{1029}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta, from Cochin State.

Syleus Thor.

1876. *Syleus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, IX, p. 114.

1923. *Syleus*, Roewer, *Weberknechte der Erde*, p. 928.

Only one species of this genus has so far been recorded.

Syleus niger (C. L. Koch).

1848. *Acanthonotus niger*, Koch, *Hahn u. C. L. Koch, Arachniden*, XVI, p. 61.

1923. *Syleus niger*, Roewer, *Weberknechte der Erde*, p. 928.

Distribution.—Bombay, India.

Akalpia Rwr.

1914. *Akalpia*, Roewer, *Arch. Naturg.*, LXXX, fasc. 9, p. 109.

1923. *Akalpia*, Roewer, *Weberknechte der Erde*, p. 951.

Only a single species of this genus has so far been described.

Akalpia oblonga Rwr.

1914. *Akalpia oblonga*, Roewer, *Arch. Naturg.*, LXXX, fasc. 9, p. 110.

1923. *Akalpia oblonga*, Roewer, *Weberknechte der Erde*, p. 952, fig. 1089.

Distribution.—Akalpa, Kandal Valley, Ratnagiri, Bombay Presidency.

Melanopa Thor.

1889. *Melanopa* (in part), Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 659.

1923. *Melanopa*, Roewer, *Weberknechte der Erde*, p. 931.

Key to the species of the genus *Melanopa*.

- | | |
|---|-----------------------------------|
| 1. 1st to 4th femora toothed and distinctly hirsute .. | 2 |
| 1st to 4th femora toothed, but not hirsute .. | 4 |
| 2. Scutum with one broad and dark median band .. | 3 |
| Scutum uniformly black-brown, without any band (Himalayas, Bengal, Burma) .. | <i>M. fragilis</i> , p. 116. |
| 3. Scutum only on the 2nd area with a single median thorn (Himalayas) .. | <i>M. hirta</i> , p. 116. |
| Scutum on the 1st and 2nd areas with two median thorns (Eastern Himalayas) .. | <i>M. transversalis</i> , p. 117. |
| 4. Ocular tubercle toothed basally under the eyes .. | 5 |
| Ocular tubercle smooth basally or only granulated as also the surface of the carapace .. | 9 |
| 5. 1st article of the chelicerae dorsally granulated .. | 6 |
| 1st article of the chelicerae dorsally smooth .. | 8 |

- | | |
|---|----------------------------------|
| 6. Scutum only on the 2nd area with a single median thorn | 7 |
| Scutum on the 1st and 2nd areas with two median thorns (Tonkin) | <i>M. scabra</i> , p. 115. |
| 7. Median thorn of the scutum smooth (India and Indo-China) | <i>M. atrata</i> , p. 116. |
| Median thorn of the scutum wholly or partially granulated (India and Indo-China) | <i>M. varians</i> , p. 115. |
| 8. Ocular tubercle with one ring of teeth around each eye (Burma) | <i>M. plebeja</i> , p. 115. |
| Ocular tubercle smooth above (India) | <i>M. hansenii</i> , p. 115. |
| 9. Humps of the marginal rows of 1st to 4th coxae straight, blunt | 10 |
| Each of the humps of marginal rows consisting of three small teeth (Matheran, Bombay) | <i>M. matherania</i> , p. 115. |
| 10. 1st article of the chelicerae dorsally granulated | 11 |
| 1st article of the chelicerae dorsally smooth (Burma) | <i>M. tristis</i> , p. 116. |
| 11. Body dorsally and ventrally uniform black-brown (India) | <i>M. unicolor</i> , p. 117. |
| Scutum with a distinct median dark-brown band | 12 |
| 12. Chelicerae and palps dark-brown, only tarsus of the latter ferruginous (Yunnan) | <i>M. yuennanensis</i> , p. 116. |
| Chelicerae and palps wholly ferruginous (Shan States) | <i>M. diluta</i> , p. 116. |

Melanopa scabra Rwr.

1912. *Melanopa scabra*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 36.

1923. *Melanopa scabra*, Roewer, *Weberknechte der Erde*, p. 939.

Distribution.—Tonkin.

Melanopa varians (With).

1903. *Gagrella varians*, With, *Journ. Linn. Soc., London, Zool.*, XXVIII, p. 503

1923. *Melanopa varians*, Roewer, *Weberknechte der Erde*, p. 934.

Distribution.—Birbhum ; Abor Country, India ; Tavoy, Burma.

Melanopa plebeja Thor.

1889. *Melanopa plebeja*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 659.

1923. *Melanopa plebeja*, Roewer, *Weberknechte der Erde*, p. 934.

Distribution.—Minhla, Prome, Burma.

Melanopa hansenii (With).

1903. *Gagrella hansenii*, With, *Journ. Linn. Soc., London, Zool.*, XXVIII, p. 503.

1923. *Melanopa hansenii*, Roewer, *Weberknechte der Erde*, p. 935.

Distribution.—Tadaspor, India.

Melanopa matherania Rwr.

1915. *Melanopa matherania*, Roewer, *Ann. Mus. Hungar.*, XIII, p. 215.

1923. *Melanopa matherania*, Roewer, *Weberknechte der Erde*, p. 939

Distribution.—Matheran, Bombay Presidency, India.

Melanopa tristis Thor.

1889. *Melanopa tristis*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 662.

1923. *Melanopa tristis*, Roewer, *Weberknechte der Erde*, p. 936.

Distribution.—Teinzo, Burma.

Melanopa yuennanensis Rwr.

1910. *Melanopa yuennanensis*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 26.

1923. *Melanopa yuennanensis*, Roewer, *Weberknechte der Erde*, p. 935.

Distribution.—Yunnan, China.

*** Melanopa fragilis** (With).

1903. *Gagrella fragilis*, With, *Journ. Linn. Soc., London, Zool.* XXVIII, p. 493.

1910. *Melanopa fragilis*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 21.

1923. *Melanopa fragilis*, Roewer, *Weberknechte der Erde*, p. 932.

Distribution.—Pashok, alt. 1,500—3,500 feet (42 males, 17 females—Gravely, Hartless *leg.*) ; Darjeeling (1 male) ; Ghumti, alt. 1,500—5,000 feet, (3 males, 5 females) ; Ghoom, alt. 4,000—5,000 feet, (1 male—Carmichael *leg.*) ; Kalimpong, East Himalayas (11 males, 7 females) ; all in Darjeeling District ; Rangamati, Chittagong Hill Tract, Bengal (1 male—Hodgart *leg.*).

*** Melanopa atrata** (Stol.)

1869. *Gagrella atrata*, Stoliczka, *Journ. Asiat. Soc., Bengal*, XXXVIII, p. 212.

1910. *Melanopa atrata*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 23.

1923. *Melanopa atrata*, Roewer, *Weberknechte der Erde*, p. 933.

Distribution.—Courtallam, Madras Presidency (4 males and females) ; Tollygunj, Calcutta, Bengal (22 males and females) ; Shillong (1 male 1 female) ; Tura, Garo Hills (1 female) ; Khasia Hills (1 female) ; all in Assam ; Phagu, alt. 8,300—8,700 feet, Simla Hills, (1 female—N. Annandale *leg.*) ; Bargakote, alt. 8,000 feet ; Kumaon (1 female—Tytler *leg.*), all in Western Himalayas.

*** Melanopa hirta** (With).

1903. *Gagrella hirta*, With, *Journ. Linn. Soc., London, Zool.*, XXVIII, p. 492.

1910. *Melanopa hirta*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 65.

1923. *Melanopa hirta*, Roewer, *Weberknechte der Erde*, p. 938.

Distribution.—Kalimpong (1 female—Sutherland *leg.*) ; Sitong, alt. 2,500 feet (10 *pulli*), Darjeeling District.

*** Melanopa diluta**, sp. nov.

Length of body of male 6, of female 7, 1st to 4th femora 6, 10, 7, 8, 1st to 4th legs 28, 50, 27, 39 mm.

Surface of carapace, scutum and free tergites and sternites of abdomen densely granulated ; scutum with two median spines of equal length, one on the 1st and the other on the 2nd area ; ocular tubercle unarmed and smooth ; surface of 1st to 4th coxae very coarsely granulated, edge of small humps of marginal rows straightly blunted. First article of chelicerae dorsally with a dense group of granules. Palps :

femur dorsally and ventrally, also patella dorsally and tibia ventrally and medially covered with small teeth; patella without an apophysis at the medial corner; tibia $2\frac{1}{2}$ times longer than wide; tarsus in the male with a ventral longitudinal row of very small granules. Legs: 1st to 4th femora covered with small teeth; number of the noduli on 1st to 4th femora 0-1-0-0.

Colour of the whole body dorsally and ventrally, of the four coxae, ocular tubercle, and the two spines of the scutum, blackish-brown; carapace on each side of the ocular tubercle and scutum on each side of the two spines mottled with lighter yellowish spots; chelicerae and palps uniformly ferruginous; legs ferruginous, but 1st to 4th trochanters and the basal ends of the 1st to 4th femora distinctly black.

Distribution.—Foot of Elephant Hill, Ywanghwe State, alt. ca. 5,700 feet, Southern Shan States (2 males, 6 females).

Type-specimens.—No. $\frac{1080}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

*** *Melanopa unicolor* Rwr.**

1912. *Melanopa unicolor*, Roewer, *Arch. Naturg.*, LXXVIII, A. 1, p. 35.

1923. *Melanopa unicolor*, Roewer, *Weberknechte der Erde*, p. 939.

Distribution.—Dehra Dun, United Provinces (1 female—Ind. Mus., Calcutta); Orissa.

*** *Melanopa transversalis* Rwr.**

1912. *Melanopa transversalis*, Roewer, *Arch. Naturg.*, LXXVIII, A. 1, p. 34.

1923. *Melanopa transversalis*, Roewer, *Weberknechte der Erde*, p. 938.

Distribution.—Ghoom, alt. 4,000—5,000 feet, Darjeeling District (1 female—Carmichael leg.—Ind. Mus., Calcutta).

***Gagrella* Thor.**

1876. *Gagrella*, Thorell, *Ann. Mus. Civ. Stor. Nat. Hist. Genova*, IX, p. 119.

1923. *Gagrella*, Roewer, *Weberknechte der Erde*, p. 952.

Out of the 86 known species of this genus 37 are found in India and Indo-China.

Key to the Indian and Indo-Chinese species of *Gagrella*.

- | | |
|---|---------------------------------|
| 1. Scutum with a metallic greenish, sulphur-yellowish, or coppery, but not golden gloss | 2 |
| Scutum without any metallic gloss | 10 |
| 2. Scutum mottled with distinct white or yellow spots | 3 |
| Scutum without any such spots, at the most paler or darker punctations or sometimes with a dark median band | 6 |
| 3. Ocular tubercle smooth or toothed only above the eyes | 4 |
| Ocular tubercle toothed below the eyes also | 5 |
| 4. 1st article of chelicerae dorsally smooth (Eastern Himalayas) | <i>G. speciosa</i> , p. 122. |
| 1st article of chelicerae dorsally with one or more teeth (Malacca) | <i>G. cyanargentea</i> . |
| 5. Chelicerae wholly black or dark-brown (Burma) | <i>G. histriónica</i> , p. 121. |
| Chelicerae wholly pale-yellowish (Burma) | <i>G. magnifica</i> , p. 120. |

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|---|----------------------------------|
| 6. Body dorsally with a metallic greenish or yellowish gloss | 7 |
| Body dorsally ferruginous or black, with a dark coppery gloss | 9 |
| 7. Body dorsally with a greenish gloss; 1st article of chelicerae dorsally smooth | 8 |
| Body dorsally with a yellowish gloss; 1st article of chelicerae dorsally densely toothed (Burma) | <i>G. sulphurea</i> , p. 123. |
| 8. Scutum without any dark median band (Deccan) | <i>G. prasina</i> , p. 123. |
| Scutum before the thorn with a dark median band (Palni Hills, Madras) | <i>G. palnica</i> , p. 125. |
| 9. 1st article of chelicerae toothed dorsally (Burma) | <i>G. aeneascens</i> , p. 120. |
| 1st article of chelicerae smooth dorsally (Assam) | <i>G. metallica</i> , p. 124. |
| 10. 1st to 4th femora toothed and distinctly hirsute | 11 |
| 1st to 4th femora toothed, but not hirsute | 12 |
| 11. Chelicerae pale yellowish (India) | <i>G. nobilis</i> , p. 121. |
| Chelicerae black (Malacca) | <i>G. aureolata</i> . |
| 12. Ocular tubercle above smooth or nearly smooth, at most with a few hairs | 13 |
| Ocular tubercle above toothed or granulated | 27 |
| 13. Scutum prevailing black or black-brown (uniformly coloured or mottled) | 14 |
| Scutum prevailing pale yellowish, ferruginous or with a golden gloss (uniformly coloured or mottled) | 22 |
| 14. Scutum uniform black or black-brown | 15 |
| Scutum black, but mottled with white or yellow | 19 |
| 15. 1st article of chelicerae dorsally smooth | 16 |
| 1st article of chelicerae dorsally with 1 to 2 teeth (India and Burma) | <i>G. feae</i> , p. 120. |
| 16. 2nd and 4th tibiae with one broad apical white ring (Malacca) | <i>G. albifrons</i> . |
| 1st to 4th tibiae uniformly coloured and without apical white rings | 17 |
| 17. 2nd article of the chelicerae near the articulation of the 1st article with one pointed tooth: the tooth white, chelicerae black (Burma) | <i>G. arthrocentra</i> , p. 122. |
| Chelicerae not armed with such a tooth | 18 |
| 18. Chelicerae black (Malacca) | <i>G. nigripalpis</i> , p. 121. |
| Chelicerae pale yellowish or ferruginous (Malacca) | <i>G. atrorubra</i> , p. 122. |
| 19. Chelicerae black or black-brown (Malacca) | <i>G. biseriata</i> , p. 121 |
| Chelicerae pale yellowish or ferruginous | 20 |
| 20. Scutum yellowish with the lateral and frontal margins black and a median black band, the median band crossed by four rows of small black points (Indo-China) | <i>G. cruciata</i> , p. 121. |
| Scutum not marked as in <i>G. cruciata</i> | 21 |
| 21. Scutum with two median thorns on 1st to 2nd areas (Burma) | <i>G. distincta</i> , p. 120. |
| Scutum with a median thorn on 1st area only (Burma) | <i>G. feae humeralis</i> . |
| 22. Carapace in front and on each side of the ocular tubercle pale-yellowish or whitish, with a few dark-brown impressed spots, front of the carapace in the middle blackish; 1st and 2nd thoracic tergites blackish or brown | 23 |
| Carapace not coloured in such a manner | 25 |
| 23. Palps uniformly coloured, pale-brown; legs uniformly coloured, but 3rd and 4th trochanters dorsally with pale spots (Tenasserim, Burma) | <i>G. lepida</i> , p. 121. |
| Palps ferruginous, but the femora apically and patellas basally brown | 24 |
| 24. 2nd femur apically with a white ring; 1st to 4th tarsi uniformly coloured (Burma) | <i>G. armillata</i> , p. 121. |
| 1st to 4th femora uniformly coloured, without paler rings, but the first articles of 2nd and 4th tarsi with distinct white rings (Assam) | <i>G. annulatipes</i> , p. 123. |

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| 25. Ocular tubercle also basally under the eyes smooth ; the whole body with a greenish, not metallic, lustre (Nilgiris, Cochin State) | <i>G. viridula</i> , p. 125. | 26 |
| Ocular tubercle basally under the eyes toothed .. | | |
| 26. Scutum only on the 2nd area with one median thorn (Burma) | <i>G. graveleyi</i> , p. 123. | |
| Scutum with two median thorns on 1st and 2nd areas (Burma) | <i>G. leucobunus</i> , p. 123. | |
| 27. Ocular tubercle also basally under the eyes toothed | | 28 |
| Ocular tubercle basally under the eyes smooth .. | | 38 |
| 28. Scutum with two median thorns | | 29 |
| Scutum with only one median thorn on the 2nd area, seldom also one very small hump on the 1st area | | 34 |
| 29. Palps wholly unarmed ; ocular tubercle basally under each eye with three teeth (Burma) .. | <i>G. armillata</i> , p. 121. | |
| Palps, at least femur, toothed ; ocular tubercle armed differently | | 30 |
| 30. Palps wholly pale-yellowish ; scutum mottled with yellow (Burma) | <i>G. distincta</i> , p. 120. | |
| Palps black-brown, or dark ferruginous, scutum not mottled, black or dark-brown, without a median band | | 31 |
| 31. Palps pale-yellowish, but femur, patella and tibia dark-brown (Tonkin) | <i>G. indochinensis</i> , p. 124. | |
| Palps ferruginous, or except for the tarsus, black- brown | | 32 |
| 32. Ocular tubercle on each side with a complete ring of teeth around each eye | | 33 |
| Ocular tubercle only above and frontally with a few teeth (India and Burma) | <i>G. feae</i> , p. 120. | |
| 33. Length of the body 3 mm. ; legs uniformly ferru- ginous (Shan States) | <i>G. parva</i> , p. 126. | |
| Length of the body 5—6 mm. ; legs brown, 1st to 4th femora and tibiae with several pale yellowish rings or spots (Andaman Islands) | <i>G. andamana</i> , p. 126. | |
| 34. Ocular tubercle nearly smooth, at the most front- ally above with a few very small granules (Burma and India) | <i>G. feae</i> , p. 120. | |
| Ocular tubercle above strongly toothed on each side of the furrow | | 35 |
| 35. Scutum uniformly black or black-brown ; carapace frontally with a median yellow spot | | 36 |
| Scutum not uniformly black or black-brown ; carapace otherwise marked | | 37 |
| 36. 1st article of chelicerae dorsally with 1—2 granules ; patella of the palp without an apophysis (Siam) | <i>G. luteofrontalis</i> , p. 123. | |
| 1st article of chelicerae dorsally densely toothed ; patella of the palp with a medial apophysis (Burma) | <i>G. scabra</i> , p. 123. | |
| 37. Humps of the marginal rows of 1st coxa straightly blunted | | 5 |
| Humps of the marginal rows of 1st coxa three- pointed (Burma) | <i>G. spinulosa</i> , p. 122. | |
| 38. Colour of the scutum prevailing black or dark- brown, uniformly coloured or mottled with small white or yellowish spots | | 39 |
| Colour of the scutum prevailing pale-yellowish or ferruginous | | 43 |
| 39. Abdomen dorsally distinctly mottled | | 40 |
| Abdomen dorsally not distinctly mottled | | 42 |
| 0. Abdomen dorsally mottled with white spots | | 5 |
| Abdomen dorsally mottled with yellow or pale- brown spots | | 41 |

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| 41. Abdomen dorsally on each side with 6-7 spots of yellow secretions (Cochin-China) .. | <i>G. flavimaculata</i> , p. 124. | |
| Abdomen dorsally on each side with one large dark-reddish spot with two smooth, nearly yellow spots behind (Tavoy, Burma) .. | <i>G. binotata</i> , p. 122. | |
| 42. Carapace on each side of the ocular tubercle thickly covered with white secretions (Burma) .. | <i>G. erebea</i> , p. 120. | |
| Carapace not covered with white secretions (Burma) .. | <i>G. patalungensis</i> , p. 122. | |
| 43. All joints of the palps only hirsute, not toothed .. | | 23 |
| Femur of the palps ventrally toothed .. | | 44 |
| 44. Length of the body 8-11 mm.; 1st to 4th tibiae apically with one white ring (Siam and Burma) | <i>G. coriacea</i> , p. 121. | |
| Length of the body at the most 8 mm.; 1st to 4th tibia without white apical rings .. | | 45 |
| 45. Carapace black or black-brown (Nicobar Islands) .. | <i>G. unispinosa</i> , p. 122. | |
| Carapace mottled with white or pale spots .. | | 46 |
| 46. Humps of the marginal rows of 1st coxa straightly blunted .. | | 47 |
| Humps of the marginal rows of 1st coxa three-pointed (Cochin China) .. | <i>G. flava</i> , p. 123. | |
| 47. Scutum yellowish or ferruginous (Burma) .. | <i>G. cervina</i> , p. 122. | |
| Scutum darker reddish-brown and on each side a little mottled with black (Siam) .. | <i>G. fulva</i> , p. 123. | |

* *Gagrella feae* Thor.

1889. *Gagrella feae*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 648.
 1923. *Gagrella feae*, Roewer, *Weberknechte der Erde*, p. 957.

Distribution.—Rangoon, Pegu, Metan, Tenasserim, Burma; Abor Country, Assam; Calcutta, Bengal; Kierpur, Purneah District, Bihar (5 females—Ind. Mus., Calcutta); Barkul, alt. 1,000 feet, Orissa (3 males, 5 females, 3 *pulli*—Ind. Mus., Calcutta).

Gagrella aenescens Thor.

1889. *Gagrella aenescens*, Thorell, *Ann. Mus. Civ. Stor. Nat., Genova*, XXVII, p. 643.
 1923. *Gagrella aenescens*, Roewer, *Weberknechte der Erde*, p. 958.

Distribution.—Mount Mooleyit, Burma.

Gagrella disticta (Thor).

1889. *Gagrella nocticolor* var. *disticta*, Thorell, *Ann. Mus. Civ. Stor. Nat., Genova*, XXVII, p. 651.
 1923. *Gagrella disticta*, Roewer, *Weberknechte der Erde*, p. 958.

Distribution.—Bhamo, Burma.

Gagrella erebea Thor.

1889. *Gagrella erebea*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 636.
 1923. *Gagrella erebea*, Roewer, *Weberknechte der Erde*, p. 959.

Distribution.—Teinzo, Bhamo, Burma.

Gagrella magnifica Rwr.

1910. *Gagrella magnifica*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 50.
 1923. *Gagrella magnifica*, Roewer, *Weberknechte der Erde*, p. 959.

Distribution.—Pegu, Burma.

Gagrella histrionica Thor.

1889. *Gagrella histrionica*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 652.

1923. *Gagrella histrionica*, Roewer, *Weberknechte der Erde*, p. 960.

Distribution.—Schwegu, Bhamo, Burma.

Gagrella coriacea Rwr.

1910. *Gagrella coriacea*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 62.

1923. *Gagrella coriacea*, Roewer, *Weberknechte der Erde*, p. 963.

Distribution.—Battambang, Burma ; Bangkok, Siam.

Gagrella lepida Thor.

1889. *Gagrella lepida*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 627.

1923. *Gagrella lepida*, Roewer, *Weberknechte der Erde*, p. 965.

Distribution.—Tenasserim (Wood-Mason), Dawna Hills, Burma ; Rotung, Abor Country (Egar).

Gagrella nigripalpis Rwr.

1910. *Gagrella nigripalpis*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 61.

1923. *Gagrella nigripalpis*, Roewer, *Weberknechte der Erde*, p. 964.

Distribution.—Malacca.

Gagrella biseriata Sim.

1901. *Gagrella biseriata* and *Gagrella illusa*, Simon, *Proc. Zool. Soc. London*, pt. ii, p. 81.

1923. *Gagrella biseriata*, Roewer, *Weberknechte der Erde*, p. 964.

Distribution.—Perak (Gunong Inas), Jalor (Bukit Besar), Jeram-Kawan, Malacca.

Gagrella armillata Thor.

1889. *Gagrella armillata*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 629.

1923. *Gagrella armillata*, Roewer, *Weberknechte der Erde*, p. 965.

Distribution.—Prome, Burma ; Darrang, Assam.

Gagrella cruciata Rwr.

1910. *Gagrella cruz*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 64.

1923. *Gagrella cruciata*, Roewer, *Weberknechte der Erde*, p. 966.

Distribution.—Pegu, Burma.

Gagrella nobilis With.

1903. *Gagrella nobilis*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 489.

1923. *Gagrella nobilis*, Roewer, *Weberknechte der Erde*, p. 966.

Distribution.—Siliguri, Bengal, India.

Gagrella patalungensis Sim.1901. *Gagrella patalungensis*, Simon, *Proc. Zool. Soc. London*, pt. ii, p. 82.1923. *Gagrella patalungensis*, Roewer, *Weberknechte der Erde*, p. 961.*Distribution*.—Patalung, Bangkokrak, Indo-China ; Siripur, Saran, Bihar, India.**Gagrella arthrocentra** (Thor.)1889. *Arthrocentrus atratus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 623.1923. *Gagrella arthrocentra*, Roewer, *Weberknechte der Erde*, p. 961.*Distribution*.—Mount Mooleyit, Burma.**Gagrella spinulosa** Thor1889. *Gagrella spinulosa*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 657.1923. *Gagrella spinulosa*, Roewer, *Weberknechte der Erde*, p. 961.*Distribution*.—Kawkareit, Moulmein, Myawadi, Upper Tenasserim, Burma.**Gagrella cervina** Sim.1887. *Gagrella cervina*, Simon, *Journ. Asiat. Soc. Bengal*, LVI, p. 115.1923. *Gagrella cervina*, Roewer, *Weberknechte der Erde*, p. 962.*Distribution*.—Dawna Hills, Meetan, Tavoy (Mita), Burma.**Gagrella binotata** Sim.1887. *Gagrella binotata*, Simon, *Journ. Asiat. Soc. Bengal*, LVI, pp. 101—107.1923. *Gagrella binotata*, Roewer, *Weberknechte der Erde*, p. 962.*Distribution*.—Tavoy, Burma.**Gagrella atrorubra** Sim.1901. *Gagrella atrorubra*, Simon, *Proc. Zool. Soc. London*, pt. ii, p. 83.1923. *Gagrella atrorubra*, Roewer, *Weberknechte der Erde*, p. 963.*Distribution*.—Perak (Gunong Inas), Malacca.**Gagrella unispinosa** (With).1903. *Gagrella imperator-unispinosa*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 502.1923. *Gagrella unispinosa*, Roewer, *Weberknechte der Erde*, p. 967.*Distribution*.—Nicobars.**Gagrella speciosa** Rwr.1911. *Gagrella speciosa*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, p. 162.1923. *Gagrella speciosa*, Roewer, *Weberknechte der Erde*, p. 967.*Distribution*.—Kurseong, Eastern Himalayas, Bengal.

***Gagrella prasina Rwr.**1911. *Gagrella prasina*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 2, p. 163.1923. *Gagrella prasina*, Roewer, *Weberknechte der Erde*, p. 968.

Distribution.—Western Ghats, Travancore (Maddathoray) ; Coonoor, alt. 5,600—6,000 feet, Nilgiris (1 female, Gravely *leg.*—Government Museum, Madras) ; Dhoni Forest, alt. 1,500—4,000 feet, South Malabar (2 females, Barnes *leg.*—Government Museum, Madras) ; Peninsular India.

Gagrella annulatipes Rwr.1912. *Gagrella annulatipes*, Roewer *Arch. Naturg.*, LXXVIII, fasc. 1, p. 28.1923. *Gagrella annulatipes*, Roewer, *Weberknechte der Erde*, p. 968.

Distribution.—Assam.

Gagrella scabra Rwr.1912. *Gagrella scabra*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 1, p. 29.1923. *Gagrella scabra*, Roewer, *Weberknechte der Erde*, p. 968.

Distribution.—Myawadi, Burma.

Gagrella leucobunus Rwr.1912. *Gagrella leucobunus*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 29.1923. *Gagrella leucobunus*, Roewer, *Weberknechte der Erde*, p. 969.

Distribution.—Dawna Hills, Burma.

Gagrella sulphurea Rwr.1912. *Gagrella sulphurea*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 30.1923. *Gagrella sulphurea*, Roewer, *Weberknechte der Erde*, p. 969.

Distribution.—Dawna Hills, Burma.

Gagrella gravelyi Rwr.1912. *Gagrella gravelyi*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 31.1923. *Gagrella gravelyi*, Roewer, *Weberknechte der Erde*, p. 970.

Distribution.—Dawna Hills, Burma.

Gagrella luteofrontalis Rwr.1910. *Gagrella luteofrontalis*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 67.1923. *Gagrella luteofrontalis*, Roewer, *Weberknechte der Erde*, p. 970.

Distribution.—Bangkok, Siam.

Gagrella fulva Rwr.1910. *Gagrella fulva*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 67.1923. *Gagrella fulva*, Roewer, *Weberknechte der Erde*, p. 971.

Distribution.—Bortong (?), Siam.

Gagrella flava Rwr.1910. *Gagrella flava*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 68.1923. *Gagrella flava*, Roewer, *Weberknechte der Erde*, p. 971.

Distribution.—Cochin-China,

Gagrella flavimaculata With.

1903. *Gagrella flavimaculata*, With, Journ. Linn. Soc. London, Zool., XXVIII, p. 498.

1923. *Gagrella flavimaculata*, Roewer, *Weberknechte der Erde*, p. 971.

Distribution.—Cochin-China.

Gagrella indochinensis Rwr.

1927. *Gagrella indochinensis*, Roewer, *Boll. Labor. Zool. Agrar. Portici*, XX, p. 208.

Distribution.—Khuoi-Tao, Tonkin.

***Gagrella metallica, sp. nov.**

Male : length of body 5, 1st to 4th femora 8, 18, 7·5, 11·5, 1st to 4th legs 46, 88, 44, 58 mm.

Female : length of body 6·5, 1st to 4th femora 9, 18, 8·5, 13, 1st to 4th legs 44, 92, 42, 58 mm.

Surface of carapace, scutum and free tergites of abdomen smooth and brilliant ; ocular tubercle high, slightly inclined, unarmed, smooth ; scutum with one median sharp and smooth spine on 2nd area ; free sternites of abdomen opaque, smooth ; surface of 1st to 4th coxae coarsely granulated, edge of small humps of marginal rows straight, blunted ; 1st article of chelicerae dorsally smooth. Palps : femur ventrally with a lateral longitudinal row of small pointed teeth and ventro-medially with an equal longitudinal, but shorter basal row of small blunt teeth, patella dorsally scattered with small teeth, tibia about four times as long as thick, entirely unarmed, tarsus unarmed, but in male with a ventral longitudinal row of small teeth. 1st to 4th legs : trochanters entirely smooth, femora sparsely covered with scattered small teeth ; number of noduli on 1st to 4th femora 0·1-0·0.

Colour of carapace blackish-brown, around the shining black ocular tubercle appearing as a pale yellowish triangle, the frontally directed point of which is traversed by a narrow black line. The two thoracic tergites and scutum with its spine and also the free tergites of abdomen very shining violet-blue ; scutum on each side with a narrow testaceous longitudinal spot, which sometimes is continued on the free tergites and often is more distinct in the female than in the male. The free sternites of abdomen and 1st to 4th coxae dark brown, more or less covered with white secretions of skin. Chelicerae distinctly light yellow, the supracheliceral lamellae black in contrast. Palps light yellow, femur brownish. Legs : trochanters and basal buttons of femora brilliant black, other limbs light yellow, 1st to 4th tibiae distally with whitish rings.

Distribution.—Cherrapunji, (2 males, 1 female, Kemp *leg.*, Types ; 1 female, 2 males, cotypes—Government Museum, Madras) ; Shillong (1 female, Kemp *leg.*, Indian Museum, Calcutta ; 1 male, Government Museum, Madras) ; Tura, Garo Hills (1 female *pullus*, Indian Museum, Calcutta) ; Assam.

Type-specimens.—No. $\frac{1024}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

***Gagrella viridula*, sp. nov.**

Male: length of body 4, 1st to 4th femora 11, 21, 10, 14, 1st to 4th legs 48, 101, 44, 67 mm.

Female: length of body 5.5, 1st to 4th femora 9, 17, 8, 12, 1st to 4th legs 41, 87, 36, 56 mm.

Surface of carapace, scutum, free tergites and sternites of abdomen and of 1st to 4th coxae smooth and polished; ocular tubercle smooth, but with 1—3 pointed small teeth above and frontally on each side of the median furrow; scutum with a slender smooth spine. Edge of small humps of marginal rows of coxae straightly blunted. 1st article of chelicerae dorsally with 3—4 granules. Palps almost unarmed; femur only ventro-basally with about 10 blunt granules, patella dorsally with about 10 scattered, small, pointed teeth, tibia about $4\frac{1}{2}$ times longer than thick, unarmed; tarsus unarmed, but in the male with a ventro-medial row of very small teeth. Legs long, thin; 1st to 4th trochanters on each side with a few teeth, rest of the legs unarmed; number of the noduli on 1st to 4th femora 0-1-0-0.

Colour of the body dorsally and ventrally ferruginous, with a brilliant greenish but not metallic lustre on the carapace, on the free thoracic tergite, on the scutum and on the free tergites and sternites of the abdomen. Ocular tubercle pale yellowish with blackish rings around the eyes. Surface of the carapace frontally and laterally covered with white secretions; 1st to 4th coxae yellowish-brown, also covered with white secretions on the marginal rows. Chelicerae and palps pale yellowish, the latter somewhat greenish dorsally. Legs with their trochanters uniform brown.

Distribution.—Ootacamund, alt. 6,700—8,900 feet (1 male, 1 female—Gravely leg.), Nilgiris; Komolapara (1 female—cotype, Indian Museum, Calcutta); Parambikulam, alt. 1,700—3,000 feet (2 *pulli*, females); Cochin State.

Type-specimens.—No. $\frac{1022}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

***Gagrella palnica*, sp. nov.**

(Fig. 3).

Length of body 5, 1st to 4th femora 8, 13, 7, 9; 1st to 4th legs 32, 55, 32, 44 mm.

Surface of carapace, scutum and free tergites and sternites of abdomen smooth, not granulated; 2nd area of scutum with one median slender

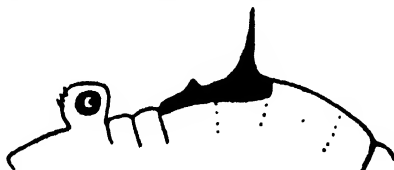


FIG. 3.—*Gagrella palnica*, sp. nov.—Left lateral view of the dorsum of the body.

and short spine, 1st area of scutum with a low and small median hump. Ocular tubercle on each side frontally with 3-4 granules. Surface of

1st to 4th coxae smooth ; edge of small humps of marginal rows of coxae straightly blunted. 1st article of chelicerae dorsally smooth. Palps : trochanter to tarsus wholly unarmed, smooth ; patella with an inner apical apophysis. Legs in femoral region sparingly denticulated ; number of the noduli on 1st to 4th femora 0-1-0-0.

Colour of the body and ocular tubercle pale yellowish ; carapace, two thoracic tergites and scutum of each side metallic-green, spine of scutum blackish-brown with a median longitudinal stripe of the same colour running from this spine to the frontal margin of scutum. 1st to 4th coxae ferruginous ; 1st to 4th trochanters and the basal buttons of the femora blackish-brown, rest of the legs, palps and chelicerae pale yellowish.

Distribution.—Kodaikanal, Palni Hills, South India (4 females, Kemp leg.—Type and cotypes).

Type-specimen.—No. $\frac{1061}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Gagrella parva, sp. nov.

Length of body, 3, 1st to 4th femora 4·5, 7·5, 4·5, 6, 1st to 4th legs 20, 38, 20, 26 mm.

Surface of carapace, scutum and free tergites of abdomen densely granulated ; ocular tubercle with a row of 6—9 teeth around each eye. Scutum with two median spines, one on each of 1st and 2nd areas. Free sternites of abdomen and surface of 1st to 4th coxae smooth, not granulated ; edge of small humps of marginal rows of coxae straightly blunted. 1st article of chelicerae dorsally granulated. Palps : femur dorsally and ventrally covered with small teeth, patella dorsally with a few teeth and apically with a medial apophysis ; tibia $5\frac{1}{2}$ times longer than broad, wholly unarmed, tarsus of male with a ventral longitudinal row of small granules. Legs : 1st to 4th trochanters and femora covered with small teeth ; number of noduli on 1st to 4th femora 0-1-0-0.

Colour of body dorsally and ventrally ferruginous, scutum in the middle somewhat darker around the two black spines, but without a distinct band, or the entire scutum uniform blackish-brown ; carapace and coxae partly covered with greyish secretions ; chelicerae and palps ferruginous, tibia and tarsus lighter yellow ; legs uniformly ferruginous.

Distribution.—Heho River, Yawnghe State, alt. ca. 3,500 feet, S. Shan States, Burma, (males and females, Gravely leg.—Types Indian Museum, Calcutta ; cotypes in Roewer collection).

Type-specimens.—No. $\frac{1034}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Gagrella andamana, sp. nov.

Male : length of body 5, 1st to 4th femora 7, 13, 7, 9, 1st to 4th legs 32, 54, 30, 40 mm.

Female : length of body 6, 1st to 4th femora 7, 11, 6, 8, 1st to 4th legs 27, 38, 25, 35 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly granulated; ocular tubercle on each side above and below the eyes finely toothed; scutum with two median spines, one on each of the 1st and 2nd areas. Free sternites of abdomen smooth, not granulated; surface of 1st to 4th coxae coarsely granulated; edge of small humps of marginal rows of coxae with 5 small teeth. 1st article of chelicerae dorsally with 2—5 small teeth. Palps: trochanter and femur strongly toothed, patella dorsally toothed, medially without an apophysis, tibia dorsally toothed, $2\frac{1}{2}$ times longer than broad, tarsus in the male with a ventral longitudinal row of small granules. Legs: 1st to 4th femora finely toothed; number of noduli on 1st to 4th femora 0-1-0-0.

Colour of the body light-ferruginous, carapace and scutum somewhat mottled with yellow on each side and behind the two darker spines on the scutum; ocular tubercle pale yellow, its median furrow darker, brown. Free sternites of abdomen pale yellow; 1st to 4th coxae darker brown, each with a pale yellow spot in the middle, and covered with white secretions. Chelicerae ferruginous, palps paler, but femur ventrally and the whole patella and tibia darker brown at their bases. Legs darker brown, femora and tibiae with several pale yellow ring-spots.

Distribution.—Port Blair, Andamans, (7 males, 3 females, 5 *pulli*; Kemp *leg.*, Type, Ind. Mus., Calcutta; cotype in Roewer collection).

Type-specimens.—No. $\frac{1042}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Scotomenia Thor.

1889. *Scotomenia*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 664.

1923. *Scotomenia*, Roewer, *Weberknechte der Erde*, p. 1029.

Only one species of this genus is found in the area under consideration.

Scotomenia cetrata Thor.

1889. *Scotomenia cetrata*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 664.

1923. *Scotomenia cetrata*, Roewer, *Weberknechte der Erde*, p. 1029.

Distribution.—Katha, Irawaddy, Schwegu, Teinzo, Burma.

Marthana Thor.

1891. *Marthana*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXX, p. 719.

1923. *Marthana*, Roewer, *Weberknechte der Erde*, p. 994.

Only one of the 5 known species of the genus is probably found in Malacca.

Marthana cornifer Lom.

1906. *Marthana cornifer*, Loman, *Mitt. Mus. Hamburg*, XXIII, p. 103.

1923. *Marthana cornifer*, Roewer, *Weberknechte der Erde*, p. 995.

Distribution.—Malacca (?)

Palniella, gen. nov.

Ocular tubercle as long as broad, as high, without large thorns or teeth. Scutum with a median blunt hump (in the male smaller than in the female) on the 2nd area only. Legs long and thin; 1st and 3rd femora $1\frac{1}{2}$ to 2 times longer than the body; 2nd femur more than twice the length of the body; number of noduli on 1st to 4th femora 0-1-0-0.

Palniella virididorsata, sp. nov.

(Fig. 4).

Length of body 4, 1st to 4th femora 7, 10, 7, 9, 1st to 4th legs 28, 49, 28, 38 mm.

Entire surface of body both dorsally and ventrally uniformly and very finely granulated; ocular tubercle wholly smooth, with a distinct longitudinal furrow; 2nd area of scutum with one median bluntly rounded hump (fig. 4). Surface of 1st to 4th coxae smooth; edge of small humps of the marginal rows of coxae straightly blunted. 1st article of chelicerae smooth dorsally. Palps wholly unarmed and smooth, except for the femur, which has ventro-basally 3—4 teeth and dorsally at the apex 1 small tooth; patella with an apophysis on the medial corner; tibia 4 times longer than broad; tarsus of male with a longitudinal row of small granules. Legs: 1st to 4th trochanters and femora slightly toothed; number of noduli on 1st to 4th femora 0-1-0-0.



FIG. 4.—*Palniella virididorsata*, gen. et sp. nov.—Left lateral view of the dorsum of the body.

Colour of the body and ocular tubercle yellow, rings of the eyes broadly black; scutum with a median, broad, blackish-green stripe, in the middle of which lies the brilliant blackish-brown hump of the 2nd area; the stripe reaches from the anterior border of the scutum to the anal operculum, and on each side of this stripe the scutum has four transverse rows of fine brown points. 1st to 4th coxae darker brown, Chelicerae and palps and legs uniformly ferruginous.

Distribution.—Kodaikanal, Palni Hills, S. India (1 male, 1 female, types;—Gravely *leg.*); Chingleput District, Kambakkam Hills (several males, cotypes in Madras Museum and Roewer collection—Gravely *leg.*), Kodaikanal (1 male, Gravely *leg.*), Kukkal (1 female, Kemp *leg.*); Palni Hills, Southern India.

Type-specimens.—No. $\frac{1046}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Dentobunus Rwr.

1910. *Dentobunus*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 31.

1923. *Dentobunus*, Roewer, *Weberknechte der Erde*, p. 940.

Key to the Continental species of *Dentobunus*.

1. Ocular tubercle, in addition to the two large frontal teeth, armed above with small teeth on each side of the longitudinal furrow 2
 Ocular tubercle smooth except for the two large frontal teeth 4
2. Ocular tubercle on each side of the longitudinal furrow above with one large and one small tooth behind it (Malacca) *D. quadridentatus*, p. 130.
 Ocular tubercle, besides the two large frontal teeth on each side of the longitudinal furrow, above with numerous small teeth 3
3. Genital operculum with a black median band; 2nd coxa basally black; the two large teeth of ocular tubercle bifurcate at their apices (South-eastern Asia) *D. ramicornis*, p. 129.
 Genital operculum and 1st to 4th coxae uniform pale yellowish; the two large teeth of ocular tubercle not bifurcate at their apices (Andamans) *D. imperator*, p. 130.
4. 1st to 4th coxae black, brown or pale-yellowish¹ 5
 1st and 3rd coxae white, 2nd coxa deep-black; the metallic violet-blue to shining black scutum with spots of white secretions (Burma) *D. magnificus*, p. 130.
5. 1st to 4th coxae brown or black¹ 6
 1st to 4th coxae pale-yellowish 8
6. Palps: femur, patella and tibia toothed, femur and patella black, tibia and tarsus pale-yellowish (Burma) *D. chaetopus*, p. 129.
 Palps: femur only hirsute, all articles pale-yellowish 7
7. Abdomen dorsally pale-yellowish with a black median band from the thorns of the scutum to anal operculum (Nicobars) *D. dentatus*, p. 129.
 Abdomen dorsally dark-brown, scutum with yellowish lateral margins and on each side of the two thorns with a large spot of white secretions; with two parallel submedian rows of yellowish spots (not covered with secretions) on the hinder part of abdomen (Malacca) *D. insignitus*, p. 130.
8. 1st to 4th trochanters and bases of femora black in contrast to the pale-yellowish coxae (Malacca) *D. acuarius*, p. 130.
 1st to 4th trochanters and coxae pale-yellowish (Burma; Malacca) *D. bicorniger*, p. 130.

Dentobunus ramicornis* (Thor.)**1894. *Gagrella ramicornis*, Thorell, *Bih. Svensk. Ak.* XX, Nr. 4, p. 16.1923. *Dentobunus ramicornis*, Roewer, *Weberknechte der Erde*, p. 641.*Distribution*.—South-East-Asia (exact locality not known).Dentobunus chaetopus* (Thor.)**1889. *Gagrella chaetopus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 631.1923. *Dentobunus chaetopus*, Roewer, *Weberknechte der Erde*, p. 942.*Distribution*.—Bhamo, Schwegu, Moulmein, Burma.***Dentobunus dentatus* (With).**1903. *Gagrella dentatus*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 488.1923. *Dentobunus dentatus*, Roewer, *Weberknechte der Erde*, p. 942.*Distribution*.—Nicobars.¹ The secretions are not taken into consideration in defining the colouration.

Dentobunus imperator (With).

1903. *Gagrella imperator*, and *imperator-dentata*, With, *Journ. Linn. Soc., Zoo'*, XXVIII, p. 501.
 1923. *Dentobunus imperator*, Roewer, *Weberknechte der Erde*, p. 943.

Distribution.—Andamans.

Dentobunus insignitus Rwr.

1910. *Dentobunus insignitus*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 37.
 1923. *Dentobunus insignitus*, Roewer, *Weberknechte der Erde*, p. 943.

Distribution.—Paulu Penang, Malacca.

Dentobunus quadridentatus Rwr.

1923. *Dentobunus quadridentatus*, Roewer, *Weberknechte der Erde*, p. 944.

Distribution.—Singapore ; Malacca.

Dentobunus acuarius (Thor.)

1891. *Gagrella acuarius*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXX, p. 695.
 1923. *Dentobunus acuarius*, Roewer, *Weberknechte der Erde*, p. 944.

Distribution.—Malacca (also Sumatra and Java).

Dentobunus bicorniger Sim.

1901. *Gagrella bicornigera*, Simon, *Proc. Zool. Soc., London*, pt. ii, p. 81.
 1923. *Dentobunus bicorniger*, Roewer, *Weberknechte der Erde*, p. 946.

Distribution.—Leghe, Lower Burma ; and Malacca.

Dentobunus magnificus Rwr.

1912. *Dentobunus magnificus*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 33.
 1923. *Dentobunus magnificus*, Roewer, *Weberknechte der Erde*, p. 947.

Distribution.—Dawna Hills, Burma.

Melanopula, gen. nov.

Ocular tubercle low, broader than high, smooth or granulated, without large spines or teeth. Scutum of abdomen with 1 or 2 median spines. Legs comparatively short and stout : 1st and 3rd femora shorter or as long as the body ; 2nd femur less than twice the length of the body ; number of noduli on 1st to 4th femur 0-2-0-0.

*** *Melanopula biceps*, sp. nov.**

Length of body 6.5 (male), 7 (female), 1st to 4th femora 6.5, 12, 6.5, 9, 1st to 4th legs 26, 51, 26, 33 mm.

Surface of carapace, scutum and free tergites and sternites of abdomen shagreened, not granulated ; ocular tubercle smooth ; scutum with four distinctly and sharply marked transverse furrows, 1st and 2nd areas of scutum, each with one slender median spine. Surface of 1st to 4th coxae uniformly and coarsely granulated, edge of small humps of the marginal rows of coxae straightly blunted. 1st article of chelicerae, dorsally smooth. Palps : femur ventro-basally with a few teeth ;

tibia and tarsus unarmed ; patella without an apophysis, dorsally and medially with a few teeth, tibia $2\frac{1}{2}$ times longer than broad. Legs : 1st to 4th femora finely toothed and spaceously hirsute ; number of noduli on 1st to 4th femora 0-2-0-0.

Colour of the body dark brown, middle of the front of carapace with a bifurcated yellowish line ; 1st and 2nd areas of the scutum on each side of the two spines with an indistinct yellowish longitudinal line marking off a faint dark median saddle. 1st to 4th coxae sparingly covered with greyish secretions. Chelicerae and palps yellowish, legs black or blackish-brown ; 1st to 4th tibiae with one pale apical ring.

Distribution.—Birch Hill, alt. 6,000—7,000 feet, Darjeeling District (1 male, 5 females, types and cotypes, Ind. Mus., Calcutta).

Type-specimens.—No. $\frac{1030}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Metagagrella Rwr.

1910. *Metagagrella*, Roewer, *Abh. Vcr. Hamburg*, XIX, fasc. 4, p. 95.

1923. *Metagagrella*, Roewer, *Weberknechte der Erde*, p. 998.

Key to the Continental species of the genus *Metagagrella*.

- | | |
|---|--------------------------------|
| 1. Humps of marginal rows of 1st to 4th coxae straightly blunted | 2 |
| Humps of marginal rows of 1st to 4th coxae three-pointed | 4 |
| 2. Chelicerae wholly pale-yellowish (Tonkin) .. | <i>M. silvestrii</i> , p. 132. |
| Chelicerae black | 3 |
| 3. Abdomen dorsally uniform black (Burma) .. | <i>M. nigra</i> , p. 132. |
| Abdomen dorsally black, but on each side with a longitudinal row of large ferruginous spots (Burma) | <i>M. biseriata</i> , p. 132. |
| 4. Scutum with two median thorns, on 1st and 2nd areas | <i>M. minax</i> , p. 131. |
| Scutum only with one median thorn on 2nd area only | 5 |
| 5. Ocular tubercle wholly smooth above (Malacca) .. | <i>M. pustulata</i> , p. 131. |
| Ocular tubercle covered with a few teeth above (Burma) | <i>M. sordidata</i> , p. 131. |

Metagagrella sordidata (Thor.)

1889. *Gagrella sordidata*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 634.

1923. *Metagagrella sordidata*, Roewer, *Weberknechte der Erde*, p. 998.

Distribution.—Mooleyit, Burma.

Metagagrella minax (Thor.)

1889. *Gagrella minax*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 638.

1923. *Metagagrella minax*, Roewer, *Weberknechte der Erde*, p. 999.

Distribution.—Meetan, Burma.

Metagagrella pustulata Rwr.

1910. *Metagagrella pustulata*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 97.

1923. *Metagagrella pustulata*, Roewer, *Weberknechte der Erde*, p. 999.

Distribution.—Malacca.

Metagagrella nigra Rwr.1912. *Metagagrella nigra*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 36.1923. *Metagagrella nigra*, Roewer, *Weberknechte der Erde*, p. 1001.*Distribution*.—Dawna Hills, Burma.**Metagagrella biseriata Rwr.**1912. *Metagagrella biseriata*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 37.1923. *Metagagrella biseriata*, Roewer, *Weberknechte der Erde*, p. 1001.*Distribution*.—Dawna Hills, Burma.**Metagagrella silvestrii Rwr.**1927. *Metagagrella silvestrii*, Roewer, *Boll. Labor. Zool. Agrar. Portici.*, XX, p. 209.*Distribution*.—Toccu-Concession, Tonkin.**Strandia Rwr.**1910. *Strandia*, Roewer, *Ent. Rundsch.*, XXVII, p. 177.1923. *Strandia*, Roewer, *Weberknechte der Erde*, p. 1008.

The species of this genus are restricted to South India and Ceylon.

Key to the species of the genus *Strandia*.

- | | |
|---|----------------------------------|
| 1. Patella of palps with one median apophysis .. | 2 |
| Patella of palps without a median apophysis .. | 5 |
| 2. 1st article of chelicerae with some small teeth dorsally .. | 3 |
| 1st article of chelicerae smooth dorsally .. | 4 |
| 3. Sternites of abdomen smooth; scutum reddish-brown with a darker median band (Deccan) .. | <i>S. triangularis</i> , p. 133. |
| Sternites of abdomen granulated; scutum golden yellowish with the median black-brown thorn (Palni Hills, Cochin) .. | <i>S. aurantiaca</i> , p. 133. |
| 4. Body and chelicerae reddish-brown; palps darker brown, but its tibia and tarsus pale-yellowish (Deccan) .. | <i>S. kanaria</i> , p. 134. |
| Body black, chelicerae dark-brown, palps black, but its tibia in the apical half and the entire tarsus pale-yellow (Palni Hills) .. | <i>S. atra</i> , p. 134. |
| 5. Chelicerae black, scutum with two median thorns (Ceylon) .. | <i>S. biseriata</i> , p. 135. |
| Chelicerae pale-yellowish, scutum with one median thorn only .. | 6 |
| 6. Ocular tubercle toothed above (Ceylon) .. | <i>S. ceylonensis</i> , p. 135. |
| Ocular tubercle smooth above .. | 7 |
| 7. 1st article of chelicerae dorsally with 2-3 small teeth .. | 8 |
| 1st article of chelicerae dorsally smooth .. | 9 |
| 8. Abdomen dorsally uniform black-brown (Deccan) .. | <i>S. gracilis</i> , p. 133. |
| Scutum on each side frontally with one golden-yellowish spot (Deccan) .. | <i>S. similis</i> , p. 133. |
| 9. Sternites of abdomen not granulated (Ceylon) .. | <i>S. bicolor</i> , p. 135. |
| Sternites of abdomen each with a row of granules .. | 10 |
| 10. Scutum with a dark-brown median band (Deccan) .. | <i>S. maindroni</i> , p. 133. |
| Scutum uniform reddish-ferruginous, without a median band (Ceylon) .. | <i>S. rubra</i> , p. 135. |

Strandia maindroni* (Sim.)**1897. *Gagrella maindroni*, Simon, *Bull. Mus. Paris*, III, p. 296.1923. *Strandia maindroni*, Roewer, *Weberknechte der Erde*, p. 1009.*Distribution*.—Matheran, Mahabaleshwar, Bangalore, India. *Strandia triangularis* (With).**1903. *Gagrella triangularis*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 499.1923. *Strandia triangularis*, Roewer, *Weberknechte der Erde*, p. 1009.

The species is represented in the present collection from :—Chalakudi (2 males, 3 females, 2 *pulli*—Gravely *leg.*) ; Forest Tramway (3 males, 3 females), Cochin State ; Nallamalais (9 males) ; Bangalore, Mysore (4 males, 6 females—Gravely *leg.*) ; Ootacamund, Nilgiris (1 male, 1 female) ; Kollara Kara (3 males, 1 female—Pillai *leg.*) ; Kodaikanal, Palni Hills (2 males, 1 female—Gravely *leg.*) ; South India.

Distribution.—Vellore (near Madras) ; Western Ghats, Satara District, Bombay ; Peninsular India.

Strandia gracilis* Rwr.**1910. *Maindronia gracilis*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 107.1923. *Strandia gracilis*, Roewer, *Weberknechte der Erde*, p. 1010.*Distribution*.—Pundaloya, South India.Strandia similis* Rwr.**1911. *Strandia similis*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, p. 168.1923. *Strandia similis*, Roewer, *Weberknechte der Erde*, p. 1911.

Distribution.—Bangalore, Western Ghats ; Travancore, Maddathoray, Dhoni Forest ; South India.

*** *Strandia aurantiaca*, sp. nov.**

Male : Length of body 3·5, 1st to 4th femora 9, 18, 8, 12, 1st to 4th legs 37, 66, 34, 50 mm.

Female : Length of body 4·5, 1st to 4th femora 8, 15, 8, 12, 1st to 4th legs 37, 61, 33, 51 mm.

Body dorsally and ventrally uniformly and coarsely granulated ; ocular tubercle on each side of the median longitudinal furrow with 3-4 scattered teeth dorsally, but basally on each side and especially in front toothed ; scutum only on 2nd area with one slender and smooth spine ; free sternites of abdomen finely granulated ; surface of 1st to 4th coxae more coarsely granulated, edge of small humps of marginal rows of coxae straightly blunted. 1st article of chelicerae with 2—4 fine teeth dorsally. Palps: trochanter ventrally toothed, femur ventrally densely covered with fine teeth, ventro-medially with a short basal row of 6-7 blunt humps and dorso-apically covered with small teeth, patella dorsally and laterally toothed, with one small medio-apical apophysis, tibia 3 times longer than broad, toothed except in medio-ventral area, where it is smooth ; tarsus unarmed, but in male with a ventral longitudinal row of very small teeth. Legs : trochanters and femora toothed ; number of noduli on 1st to 4th femora 0-3-0-0.

Colour of the body golden-yellow; dorsally ocular tubercle with black rings around the eyes; spine of the scutum and its wide base blackish-brown. Free sternites of the abdomen and 1st to 4th coxae ferruginous, the latter more or less covered with whitish secretions. Chelicerae, palps, and legs uniformly ferruginous.

Distribution.—Trichur (3 males, 1 female, 2 *pulli*—Gravely *leg.* type-specimens); Chalakudi (2 males, 6 females, 6 *pulli*—Gravely *leg.*; cotypes); 1 female without definite locality; Cochin State; Kodaikanal, Palni Hills, (1 male, 2 females); Madras (2 males, 4 females); S. India.

Type-specimens.—No. $\frac{1018}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

* ***Strandia kanaria*, sp. nov.**

Length of body 6 (male), 8 (female), 1st to 4th femora 11, 18, 11, 14, 1st to 4th legs, ?, ?, 52, 66 mm.

Surface of carapace, scutum and free tergites of abdomen densely and coarsely granulated; ocular tubercle on each side of the smooth median furrow dorsally with 3-4 small teeth and basally under the eyes distinctly toothed; only 2nd area of scutum with one median spine. Free sternites of abdomen covered with coarse granules; surface of 1st to 4th coxae coarsely granulated, edge of small humps of the marginal rows of 1st to 4th coxae straightly blunted. 1st article of chelicerae smooth dorsally. Palps: femur densely and coarsely toothed ventrally, patella densely toothed medially and dorsally, with a short medio-apical apophysis, tibia $3\frac{1}{2}$ times longer than broad, tarsus in female unarmed, in male with a ventral longitudinal row of very small teeth. Legs: femora toothed; number of noduli on 1st to 4th femora 0-3-0-0.

Colour of the body dark brown, 1st to 4th coxae covered with white secretions. Chelicerae reddish-brown, palps dark-brown, but tibia and tarsus paler, ferruginous; legs dark-brown.

Distribution.—Talewadi near Castle Rock, N. Kanara District (1 male, 1 female—Kemp *leg.*; Types); Western Ghats.

Type-specimens.—No. $\frac{1049}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

* ***Strandia atra*, sp. nov.**

Male: length of body 4.5, 1st to 4th femora 10, 15, 9, 13, 1st to 4th legs 39, 79, 44, 58 mm.

Female: length of body 7, 1st to 4th femora 9, 15, 9.5, 12, 1st to 4th legs 40, 78, 38, 52 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly granulated; ocular tubercle smooth, but basally under the eyes on each side with 3-4 teeth; only 2nd area of scutum with one slender, median spine. Free sternites of abdomen each with one distinct row of coarse granules; surface of 1st to 4th coxae densely and coarsely granulated, edge of small humps of the marginal rows of coxae straightly blunted. 1st article of chelicerae smooth dorsally. Palps: femur densely toothed ventrally, patella densely toothed dorsally, with a short medio-apical

apophysis, tibia 3 times longer than broad ; in male unarmed, in female ventrally toothed, tarsus unarmed, but in male with a ventral longitudinal row of small teeth. Legs : femora toothed ; number of noduli on 1st to 4th femora 0-3-0-0.

Colour of body black, only the frontal middle of carapace with a narrow pale yellow stripe ; carapace and scutum uniformly covered with white secretions ; 1st to 4th coxae densely covered with such secretions. Chelicerae dark-brown, palps black, but tibia in the apical half and the whole tarsus pale yellow.

Distribution.—Law's Ghat Road, Palni Hills (4 males, 3 females—Gravelly leg. ; Types) ; Peninsular India.

Type-specimens.—No. $\frac{1050}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

**Strandia ceylonensis* (Karsch).

1891. *Gagrella ceylonensis*, Karsch, *Berlin Ent. Zeitz.*, XXXVI, p. 308.

1923. *Strandia ceylonensis*, Roewer, *Weberknechte der Erde*, p. 1011.

The species is represented in the collection before me from Peradeniya, Ceylon (1 female—Fletcher leg.).

Distribution.—Pusselawa, Nalanda, Peradeniya, Hakgala, Ceylon.

Strandia rubra (Rwr.)

1910. *Maindronia rubra*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 109.

1923. *Strandia rubra*, Roewer, *Weberknechte der Erde*, p. 1011.

Distribution.—Ceylon (exact locality not known).

Strandia biseriata Rwr.

1912. *Strandia biseriata*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 38.

1923. *Strandia biseriata*, Roewer, *Weberknechte der Erde*, p. 1012.

Distribution.—Kandy, Ceylon.

Strandia bicolor Rwr.

1915. *Strandia bicolor*, Roewer, *Arch. Naturg.*, LXXXI, fasc. 3, p. 151.

1923. *Strandia bicolor*, Roewer, *Weberknechte der Erde*, p. 1012.

Distribution.—Nuwara, Ceylon.

Crassicippus Rwr.

1910. *Crassicippus*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 100.

1923. *Crassicippus*, Roewer, *Weberknechte der Erde*, p. 1004.

Key to the Continental species of the genus *Crassicippus*.

- | | | |
|--|--------------------------------|---|
| 1. Ocular tubercle dorsally on each side with two teeth (Malacca, Burma) | <i>C. nigerrimus</i> , p. 136. | 2 |
| Ocular tubercle wholly smooth dorsally | | 3 |
| 2. Scutum black, with yellow or white secretions | | 3 |
| Scutum with two or four spots, but these not covered with secretions (secretions may be present in other manner) | | 4 |

3. Sternites of abdomen each with a row of granules ;
carapace narrowly margined with white
secretions (Malacca) *C. semigranulosus*, p. 136.
- Sternites of abdomen without rows of granules ;
carapace on each side covered with a "0" of
white secretions (Malacca) *C. figuratus*, p. 136.
4. Scutum with a lateral yellow marginal band
(Assam) *C. signatus*, p. 136. 5
Scutum with four yellowish longitudinal bands ..
5. 1st article of chelicerae dorsally with one small
tooth or wholly smooth (Tavoy) *C. quadrivittatus*, p. 136.
1st article of chelicerae dorsally densely toothed
(Burma) *C. speciosus*, p. 136.

Crassicippus semigranulosus (Sim.)

1901. *Gagrella semigranosa*, Simon, *Proc. Zool. Soc. London*, II, p. 83.

1923. *Crassicippus semigranulosus*, Roewer, *Weberknechte der Erde*, p. 1005.

Distribution.—Bukit Besar, Jalor ; Gedong, Perak.

Crassicippus nigerrimus Rwr.

1910. *Crassicippus nigerrimus*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4,
p. 102.

1923. *Crassicippus nigerrimus*, Roewer, *Weberknechte der Erde*, p. 1005.

Distribution.—Malacca ; Dawna Hills, Burma.

Crassicippus figuratus Rwr.

1923. *Crassicippus figuratus*, Roewer, *Weberknechte der Erde*, p. 1006.

Distribution.—Singapore ; Malacca.

Crassicippus quadrivittatus (Sim.)

1887. *Gagrella quadrivittata*, Simon, *Journ. Asiat. Soc. Bengal*, XXXVIII,
p. 214.

1923. *Crassicippus quadrivittatus*, Roewer, *Weberknechte der Erde*, p. 1006.

Distribution.—Tavoy, Burma.

Crassicippus signatus (Stol.)

1869. *Gagrella signata*, Stoliczka, *Journ. Asiat. Soc. Bengal*, XXXVIII, p. 214

1923. *Crassicippus signatus*, Roewer, *Weberknechte der Erde*, p. 1007.

Distribution.—Assam.

Crassicippus speciosus Rwr.

1912. *Crassicippus speciosus*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 46.

1923. *Crassicippus speciosus*, Roewer, *Weberknechte der Erde*, p. 1008.

Distribution.—Dawna Hills, Burma.

Aurivilliola Rwr.

1910. *Aurivilliola*, Roewer, *Ent. Rundsch.*, XXVII, p. 177.

1923. *Aurivilliola*, Roewer, *Weberknechte der Erde*, p. 1002,

Key to the Continental species of the genus *Aurivilliola*.

- | | | |
|--|----------------------------------|---|
| 1. Body dorsally and ventrally hirsute (Burma) .. | <i>A. hirsuta</i> , p. 137. | 2 |
| Body not hirsute | | |
| 2. 1st article of chelicerae dorsally smooth .. | | 3 |
| 1st article of chelicerae dorsally toothed .. | | 4 |
| 3. Ocular tubercle wholly smooth; scutum only with one median thorn (Palni Hills) .. | <i>A. nigripalpis</i> , p. 138. | |
| Ocular tubercle toothed above; scutum with two median thorns (Nilgiris) .. | <i>A. biispinifera</i> , p. 138. | |
| 4. Patella of palps with a median apophysis (Deccan) .. | <i>A. palpalis</i> , p. 137. | 5 |
| Patella of palps without a median apophysis .. | | |
| 5. Scutum with two median thorns (Indo-China) .. | <i>A. annamensis</i> , p. 137. | |
| Scutum with one median thorn only (Shan States) .. | <i>A. shanica</i> , p. 137. | |

Aurivilliola hirsuta* Rwr.**1912. *Aurivilliola hirsuta*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 47.1923. *Aurivilliola hirsuta*, Roewer, *Weberknechte der Erde*, p. 1003.*Distribution*.—Dawna Hills, Burma.Aurivilliola palpalis* Rwr.**1915. *Aurivilliola palpalis*, Roewer, *Arch. Naturg.*, LXXXI, fasc. 3, p. 147.1923. *Aurivilliola palpalis*, Roewer, *Weberknechte der Erde*, p. 1004.*Distribution*.—Bombay, Peninsular India.***Aurivilliola annamensis* Rwr.**1927. *Aurivilliola annamensis*, Roewer, *Boll. Labor. Zool. Agrar. Portici*, XX, p. 209.*Distribution*.—Annam (Vinh), Indo-China.*** *Aurivilliola shanica*, sp. nov.**

Male: length of body 5, 1st to 4th femora 5, 8, 5, 7, 1st to 4th legs 23, 42, 23, 30 mm.

Female: length of body 6.5, 1st to 4th femora 6.6, 9, 5, 7, 1st to 4th legs 24, 44, 24, 31 mm.

Surface of carapace, scutum and free tergites and sternites of abdomen densely and uniformly granulated; ocular tubercle on each side of the longitudinal furrow and also under the eyes finely toothed; scutum on the 2nd area only with one median spine. Surface of 1st to 4th coxae coarsely and uniformly granulated, edge of small humps of the marginal rows of coxae straightly blunted. 1st article of chelicerae dorsally toothed. Palps: femur ventrally and dorsally toothed, patella without an apophysis, dorsally and ventrally toothed, tibia twice as long as broad, ventro-basally toothed. Legs: 1st to 4th trochanters and femora sparsely toothed; number of noduli on 1st to 4th femora 0-3-0-0.

Colour of the body and ocular tubercle dark-brown, only the longitudinal furrow pale-yellow; 1st to 4th coxae and carapace covered with greyish-white secretions. Chelicerae dark-brown, palps dark-brown, but tibia and tarsus paler brown. Legs uniformly brown.

Distribution.—Yawngnaw State, Heho River, alt. 4,000 feet, S. Shan States (4 males, 12 females—Gravely leg.; Types and cotypes).

Type-specimens.—No. $\frac{1035}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

The diagnoses of the following two new species, which were collected by Dr. J. Carl (Geneva) in South India in 1926, will be published this year in *Revue Suisse de Zoologie* in a paper entitled "Reise von Dr. J. Carl.....".

***Aurivilliola bispinifera* Rwr.**

Distribution.—Peninsular India.

***Aurivilliola nigripalpis* Rwr.**

Distribution.—Upper and Lower Palni Hills, Peninsular India.

***Gagrellula* Rwr.**

1910. *Gagrellula*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 110.

1923. *Gagrellula*, Roewer, *Weberknechte der Erde*, p. 1012.

Key to the Continental species of the genus *Gagrellula*.

- | | |
|--|----------------------------------|
| 1. Patella of palps with a median apophysis .. | 2 |
| Patella of palps without a median apophysis .. | 3 |
| 2. Ocular tubercle on each side with only two teeth above; femur of palps wholly unarmed (India) | <i>G. cruz</i> , p. 139. |
| Ocular tubercle on each side with a row of teeth above; femur of palps strongly toothed (Nilgiris) | <i>G. albilineata</i> , p. 139. |
| 3. Femur of palps wholly unarmed | 4 |
| Femur of palps ventrally toothed | 5 |
| 4. Body ferruginous, but with a greenish (not metallic) gloss (Deccan) | <i>G. virescens</i> , p. 139. |
| Body dorsally ferruginous to brown, with a darker median band (Ceylon) | <i>G. vittata</i> , p. 139. |
| 5. Ocular tubercle toothed above (sometimes only 1-2 teeth on each side) | 6 |
| Ocular tubercle smooth above | 7 |
| 6. 1st article of chelicerae dorsally smooth (Malacca) | <i>G. bimaculata</i> , p. 138. |
| 1st article of chelicerae dorsally toothed (Burma) | <i>G. bipunctata</i> , p. 139. |
| 7. Chelicerae black or black-brown | 8 |
| Chelicerae pale ferruginous or yellow | 10 |
| 8. 1st to 3rd trochanters black, each with a yellowish-white spot behind (Burma) | <i>G. melanotarsus</i> , p. 139. |
| 1st to 4th trochanters wholly black | 9 |
| 9. Scutum reddish-brown with a black median band (Burma) | <i>G. rufoscutum</i> , p. 139. |
| Scutum black with two parallel longitudinal rows of white spots of secretions (Palni Hills) | <i>G. saddlana</i> , p. 140. |
| 10. 1st article of chelicerae dorsally with 3-4 granules (Malacca) | <i>G. aurilimbata</i> , p. 139. |
| 1st article of chelicerae dorsally smooth (Deccan) | <i>G. unicolor</i> , p. 139. |

***Gagrellula bimaculata* Rwr.**

1911. *Gagrellula bimaculata*, Roewer, *Notes Leyden Mus.*, XXXIII, p. 256.

1923. *Gagrellula bimaculata*, Roewer, *Weberknechte der Erde*, p. 1017,

Distribution.—Kedah, Malacca,

Gagrellula aurilimbata Rwr.

1923. *Gagrellula aurilimbata*, Roewer, *Weberknechte der Erde*, p. 1017.

Distribution.—Singapore; Malacca.

Gagrellula melanotarsus (Rwr.).

1911. *Gagrella melanotarsus*, Roewer, *Arch. Naturg.*, LXXVII, p. 166.

1923. *Gagrellula melanotarsus*, Roewer, *Weberknechte der Erde*, p. 1018.

Distribution.—Mudon (near Moulmein), Burma.

*** Gagrellula unicolor** Rwr.

1916. *Gagrellula unicolor*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 118.

1923. *Gagrellula unicolor*, Roewer, *Weberknechte der Erde*, p. 1020.

Distribution.—Ootacamund, Deccan. Represented in this collection from: Kavalai (2 females—Gravely leg.); Parabikulam (7 females—Gravely leg.); Cochin State; Kambakkam Hill, alt. 200-800 feet (2 males—Gravely leg.), Chingleput District, Madras Presidency.

Gagrellula virescens Rwr.

1910. *Gagrellula virescens*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 118.

1923. *Gagrellula virescens*, Roewer, *Weberknechte der Erde*, p. 1020.

Distribution.—Ootacamund, Peninsular India.

Gagrellula cruz (With).

1903. *Gagrella cruz*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 490.

1923. *Gagrellula cruz*, Roewer, *Weberknechte der Erde*, p. 1020.

Distribution.—Punkabari, Assam.

Gagrellula bipunctata (Rwr.).

1912. *Gagrella bipunctata*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 42.

1923. *Gagrellula bipunctatula*, Roewer, *Weberknechte der Erde*, p. 1021.

Distribution.—Myawadi, Amherst District, Burma.

Gagrellula rufoscutum Rwr.

1912. *Gagrella rufoscutum*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 43.

1923. *Gagrellula rufoscutum*, Roewer, *Weberknechte der Erde*, p. 1021.

Distribution.—Dawna Hills, Burma.

Gagrellula vittata Rwr.

1912. *Gagrellula vittata*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 44.

1923. *Gagrellula vittata*, Roewer, *Weberknechte der Erde*, p. 1022.

Distribution.—Nuwara, Ceylon.

Gagrellula albilineata Rwr.

The diagnosis of this new species, which was collected by Dr. J. Carl of Geneva in the Nilgiris in 1926, will be published this year in *Revue Suisse de Zoologie* in a paper entitled "Reise von Dr. J. Carl."

* *Gagrellula saddlana*, sp. nov.

(Fig. 5).

Male : length of body 4, 1st to 4th femora 7, 11, 6, 9, 1st to 4th legs 28, 48, 27, 37 mm.

Female : length of body 6, 1st to 4th femora 6, 10, 6, 8.5, 1st to 4th legs 28, 39, 26, 36 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly and coarsely granulated; ocular tubercle smooth all over; only 2nd area of scutum with a median spine. Free sternites of abdomen granulated; surface of 1st to 4th coxae sparingly and coarsely granulated, edge of small humps of marginal rows of coxae straightly blunted. 1st article of chelicerae smooth dorsally. Palps: femur sparingly and

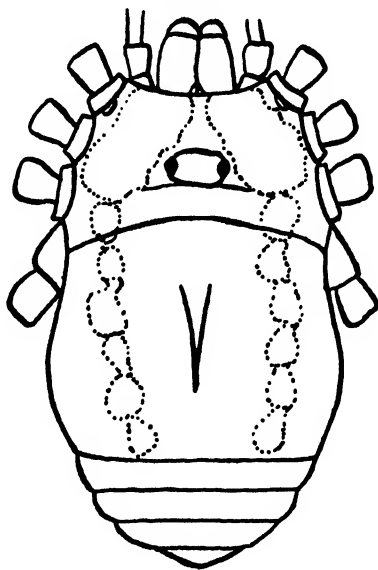


FIG. 5. — *Gagrellula saddlana*, sp. nov.—Dorsal view of the body without legs; the outlines of the white secretion-spots are dotted.

irregularly toothed ventrally, medially with a basal row of 6-8 coarse teeth, patella toothed, without apophysis, tibia $3\frac{1}{2}$ times longer than broad, smooth; tarsus unarmed, but in male with a ventral longitudinal row of small teeth. Legs: femora finely toothed; number of noduli on 1st to 4th femora 0-3-0-0.

Colour of the body black; carapace on each side of the black ocular tubercle covered with white secretions, less in the female than in the male. Scutum with a few ferruginous spots midway between the lateral margin and the median spine of the scutum, the spots are also covered with white secretions; the secretions are also present on the spaces between the four coxae and on the surface of the free sternites of the abdomen. Chelicerae and palps blackish-brown, only tarsus of palps paler brown in male or pale-ferruginous.

Distribution.—Palni Hills, Neutral Saddle, Peninsular India (3 males 2 females—Kemp leg.; Types).

Type-specimens.—No. $\frac{1048}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Paradentobunus Rwr.

1915. *Paradentobunus*, Roewer, *Arch. Naturg.*, LXXXI, fasc. 3, p. 150.

1923. *Paradentobunus*, Roewer, *Weberknechte der Erde*, p. 949.

Only a single species of this genus has so far been recorded from the area.

Paradentobunus aureomaculatus Rwr.

1915. *Paradentobunus aureomaculatus*, Roewer, *Arch. Naturg.*, LXXXI, fasc. 3, p. 150.

1923. *Paradentobunus aureomaculatus*, Roewer, *Weberknechte der Erde*, p. 949.

Distribution.—Darjeeling, Eastern Himalayas.

Marthanella Rwr.

1910. *Marthanella*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 129.

1923. *Marthanella*, Roewer, *Weberknechte der Erde*, p. 1030.

Only one of the three known species occurs within the limits of Continental India.

Marthanella ferruginea Rwr.

1911. *Marthanella ferruginea*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, p. 165.

1923. *Marthanella ferruginea*, Roewer, *Weberknechte der Erde*, p. 1030.

Distribution.—Kakhyen Hills, Burma; also known from Java and Malacca.

Eugagrella Rwr.

1910. *Eugagrella*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 119.

1923. *Eugagrella*, Roewer, *Weberknechte der Erde*, p. 1023.

Key to the Continental species of the genus *Eugagrella*.

- | | |
|---|--------------------------------|
| 1. Femur of palps toothed | 2 |
| Femur of palps not toothed (Burma) | <i>E. rufescens</i> , p. 142. |
| 2. Ocular tubercle toothed basally under the eyes | |
| (Tenasserim) | <i>E. stoliczkae</i> , p. 142. |
| Ocular tubercle smooth basally under the eyes or | |
| only granulated similarly as the surface of | |
| carapace | 3 |
| 3. 1st article of chelicerae dorsally smooth (Deccan) | <i>E. barnesi</i> , p. 142. |
| 1st article of chelicerae dorsally granulated | 4 |
| 4. Scutum golden-yellowish or pale-brown with a | |
| darker brown median band (Burma) | <i>E. laticlavia</i> , p. 141. |
| Scutum black with white secretions | 5 |
| 5. Scutum with two S-like bands of white secretions | |
| (Palni Hills) | <i>E. palnica</i> , p. 142. |
| Scutum with irregular spots of white secretions | |
| (Nilgiris) | <i>E. carli</i> , p. 143. |

Eugagrella laticlavia (Thor.)

1889. *Gagrella laticlavia*, Thorell, *Ann. Mus. Civ. Stor. Nat. Hist. Genova*, XXVII, p. 641.

1923. *Eugagrella laticlavia*, Roewer, *Weberknechte der Erde*, p. 1026.

Distribution.—Mooleyit, Burma.

Eugagrella stoliczkae (With).

1903. *Gagrella stoliczkae*, With, Journ. Linn. Soc. London, Zool., XXVIII, p. 497.

1923. *Eugagrella stoliczkae*, Roewer, Weberknechte der Erde, p. 1027.

Distribution.—Tenasserim, Burma.

Eugagrella rufescens (Thor.)

1889. *Gagrella rufescens*, Thorell, Ann. Mus. Civ. Stor. Nat. Genova, XXVIII, p. 645.

1923. *Eugagrella rufescens*, Roewer, Weberknechte der Erde, p. 1027.

Distribution.—Mooleyit, alt. 600-1900, Dawna Hills, Burma.

*** Eugagrella barnesi**, sp. nov.

Length of body 4, 1st to 4th femora 10, 15, 10, 13, 1st to 4th legs 42, 75, 43, 54 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly granulated; ocular tubercle wholly smooth; only 2nd area of scutum with one slender spine. Free sternites of abdomen each with a row of small granules; surface of 1st to 4th coxae very coarsely granulated, edge of small humps of marginal rows of 1st to 4th coxae straightly blunted. 1st article of the chelicerae dorsally smooth. Palps: femur, ventrally toothed, patella without an apophysis, dorsally with a few small and scattered teeth, tibia $3\frac{1}{2}$ times longer than broad, smooth, tarsus smooth, but ventrally with a longitudinal row of very small teeth. Legs: femora toothed, number of noduli on 1st to 4th femora 0-4-0-0.

Colour of body dorsally and ventrally and of ocular tubercle black, carapace covered thickly with white secretions around the ocular tubercle, scutum covered with some small spots of white secretions, margins of 1st to 4th coxae also covered with such secretions. Chelicerae blackish-brown, palps blackish-brown, but their tibiae in their apical halves and the entire tarsus pale yellow.

Distribution.—Netterikal Region, Kalakkad Forest, alt. 3000-5000 feet, Tinnevely District (1 male, 1 *pullus*—Barnes leg.; Type).

Type-specimen.—No. $\frac{1078}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

*** Eugagrella palnica**, sp. nov.

(Fig. 6).

Length of body 4, 1st to 4th femora 9, 17, 8.5, 12, 1st to 4th legs 42, 68, 40, 57 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly and coarsely granulated; ocular tubercle smooth all over, only 2nd area of scutum with one median spine. Free sternites of abdomen smooth; surface of 1st to 4th coxae sparsely and coarsely granulated, edge of small humps of marginal rows of coxae straightly blunted. 1st article of chelicerae dorsally with 3-4 small teeth. Palps: femur very sparsely scattered with small teeth ventrally, patella unarmed and without apophysis, tibia $2\frac{1}{2}$ times longer than wide, unarmed, tarsus unarmed,

but in male with a ventral longitudinal row of very small teeth. Legs: femora toothed; number of noduli on 1st to 4th femora 0-4-0-0.

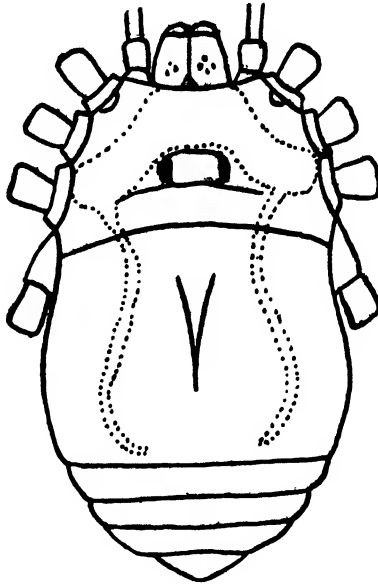


FIG. 6.—*Eugagrella palnica*, sp. nov.—Dorsal view of the body without legs; the outlines of the white secretion-stripes are dotted.

Colour of body black, carapace in front of the ocular tubercle with a broad median saddle of white secretions; this saddle extends on each side of scutum to its posterior margin as a small but distinct S-shaped line of white secretions. 1st to 4th coxae and the free sternites of the abdomen covered with white secretions. Chelicerae black, palps black, but apical half of tibia and the whole tarsus pale yellow.

Distribution.—Palni Hills, Law's Ghat Road, Peninsular India (1 male—Gravely leg.).

Type-specimen.—No. $\frac{1079}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

***Eugagrella carli* Rwr.**

The diagnosis of this new species, which was collected by Dr. J. Carl (Geneva) in South India in 1926, will be published this year in *Revue Suisse de Zoologie*.

***Neogagrella* Rwr.**

1913. *Neogagrella*, Roewer, *Arch. Naturg.*, LXXIX, fasc. 10, p. 77.

1923. *Neogagrella*, Roewer, *Weberknechte der Erde*, p. 1032.

Only two species of this genus are known so far, one from Celebes and the second described below from Peninsular India.

*** *Neogagrella barnesi*, sp. nov.**

Length of body 6, 1st to 4th femora 7, 13, 7, 11, 1st to 4th legs 37, 68, 35, 51 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly granulated; ocular tubercle smooth or in front with 2-3 very small granules; only 2nd area of scutum with one slender vertical spine. Free sternites of abdomen smooth, not granulated; surface of the 1st to 4th coxae coarsely granulated, edge of small humps of marginal rows of 1st to 4th coxae straightly blunted. 1st article of chelicerae smooth dorsally. Palps: femur coarsely toothed ventrally, patella without an apophysis, toothed all round, tibia $2\frac{1}{2}$ times longer than broad, dorso-basally toothed; tarsus unarmed, smooth. Legs: femora toothed, number of noduli on 1st to 4th femora 1-4-1-2.

Colour of body blackish-brown dorsally and ventrally, ocular tubercle blackish-brown above, but basally pale yellow; carapace around the ocular tubercle thickly covered with white secretions, which are wanting only on the two parallel ferruginous stripes on the front of the carapace; scutum from in front of its spine to its coxae similarly covered with secretions. Chelicerae blackish-brown; palps dark brown but their tibiae in their apical halves and the entire tarsus pale yellow. Legs blackish-brown, but tibia to tarsus paler brown.

Distribution.—Netterikal Region, Kalakkad Forest, alt. 3000-5000 feet, Tinnevely District, Peninsular India (4 females, 1 *pullus*—Barnes leg.).

Type-specimens.—No. $\frac{1077}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Gagrellenna, gen. nov.

Ocular tubercle as high as broad, as long; basally constricted, unarmed and without large spines or thorns. Scutum of abdomen with one median spine on the 2nd area. Legs very long and thin; 1st and 3rd femora much longer than the body, and 2nd femur much longer than twice the length of the body; number of noduli on 1st to 4th femora 1-4-1-1.

*** *Gagrellenna bipunctata*, sp. nov.**

Male: length of body 3.5, 1st to 4th femora 13, 28, 11, 16, 1st to 4th legs 55, 123, 52, 74 mm.

Female: length of body 4, 1st to 4th femora 12, 25, 11, 16, 1st to 4th legs 55, 99, 52, 74 mm.

Dorsal surface of body uniformly and finely granulated; ocular tubercle slightly inclined, distinctly furrowed and entirely smooth; scutum only on 2nd area with one slender median spine. Free sternites of abdomen each with one row of fine granules; surface of 1st to 4th coxae sparsely but coarsely granulated, edge of humps of marginal rows of coxae straightly blunted. 1st article of chelicerae smooth dorsally. Palps: trochanter with 2 small teeth ventrally, femur ventrally with a complete longitudinal row of 8-10 pointed teeth and ventro-medially with a basal row of 6 blunt humps, patella dorsally, medially and laterally toothed, without apophysis; tibia $3\frac{1}{2}$ times longer than broad, entirely unarmed; tarsus unarmed, but in male with a ventral row of very small

teeth. Legs: 1st to 4th trochanters and femora sparsely toothed; number of noduli on 1st to 4th femora 1-4-1-1.

Colour of body ferruginous; ocular tubercle bright black, its furrow ferruginous; scutum on each side of the dark brown median spine with one pale yellowish round spot (not covered with secretions). Free sternites of abdomen and 1st to 4th coxae pale ferruginous, marginal rows of abdomen with scattered white secretions; similar scattered secretions also cover the free sternites. Chelicerae pale yellowish; palps ferruginous, but tibia and tarsus paler. Legs uniformly pitch-brown.

Distribution.—Kavalai (1 male, 1 female—Gravely *leg.*; Types). Forest Tramway mile (2 males, 2 females, 1 *pullus*—Gravely *leg.*), Cochin State; Coonoor Ghat, alt. 5500 feet, Nilgiris (1 male, 3 females, 3 *pulli*—Gravely *leg.*).

Type-specimens.—No. $\frac{1060}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Coonoora, gen. nov.

Ocular tubercle as high as broad, as long, basally constricted, above on each side of the longitudinal furrow with one anterior spine. Scutum of abdomen with one median spine on the 2nd area. Legs long and thin: 1st and 3rd femora much longer than body and 2nd femur much longer than twice the length of the body; number of noduli on 1st to 4th femora 1-4-1-1.

*** Coonoora biceratops, sp. nov.**

(Fig. 7).

Length of body 5, 1st to 4th femora 10, 19, 11, 14, 1st to 4th legs 38, 78, 40, 55 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly covered with very small round pits, not granulated; ocular tubercle bright and smooth, except dorsally, on each side of the furrow, with one anterior small somewhat forwardly directed spine; only 2nd area of scutum with one short, but pointed and smooth, somewhat recurved spine. Free sternites of abdomen sparsely granulated; surface of 1st to 4th coxae very coarsely granulated, edge of small humps of marginal rows of coxae three-pointed. 1st article of chelicerae dorsally smooth. Palps: trochanter dorsally smooth and ventrally toothed, femur ventrally with strong teeth, dorsally little hirsute, patella dorsally and on each side densely toothed, but ventrally smooth, its medio-apical apophysis also densely toothed, tibia $3\frac{1}{2}$ times longer than broad, toothed, but smooth ventro-medially; tarsus in female with one ventral longitudinal row of stout teeth and one ventro-medial shorter longitudinal row of smaller teeth. Legs: femora toothed; number of noduli on 1st to 4th femora 1-4-1-1.

Colour of body dorsally and ventrally and of 1st to 4th coxae brown ocular tubercle blackish-brown with pale base; 1st to 4th coxae densely covered with white secretions. Chelicerae and palps pale yellowish,

teeth of palps tipped black. Legs dark brown, only 2nd tibia with a pale apical ring.

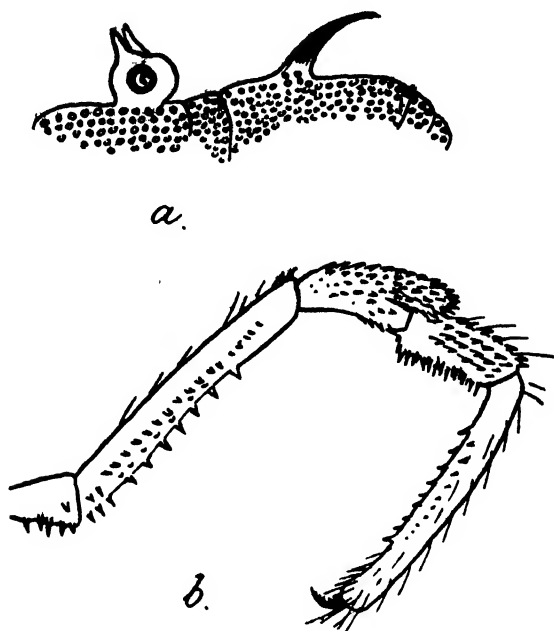


FIG. 7.—*Coonoora biceratops*, gen. et sp. nov.—(a) Left lateral view of the dorsum of the body; (b) medial view of the left palp of the male.

Distribution.—Coonoor, alt. 5700-6000 feet, Nilgiris (1 female—Gravely leg. : Type).

Type-specimen.—No. $\frac{1076}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Hologagrella Rwr.

1910. *Hologagrella*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 126.

1923. *Hologagrella*, Roewer, *Weberknechte der Erde*, p. 1027.

Two of the three species of this genus occur in the Celebes and Philippine Islands, while the third is found in Malacca.

Holgagrella reticulata Rwr.

1910. *Holgagrella reticulata*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 126.

1923. *Holgagrella reticulata*, Roewer, *Weberknechte der Erde*, p. 1028.

Distribution.—Malacca.

Nilgirisia, gen. nov.

Ocular tubercle as high as broad, as long, without large spines or thorns. Scutum of abdomen with one median spine on 2nd area. Legs long and thin; 1st and 3rd femora longer than the body and 2nd femur much longer than twice the length of the body; number of noduli on 1st to 4th femora 2-7-2-3,

* *Nilgirisia graveleyi*, sp. nov.

Male : length of body 3.5, 1st to 4th femora 12, 18, 10, 15, 1st to 4th legs 55, 106, 49, 73 mm.

Female : length of body 5, 1st to 4th femora 9, 18, 9, 11.5, 1st to 4th legs 45, 95, 45, 59 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly and finely granulated ; ocular tubercle distinctly furrowed and wholly smooth ; only 2nd area of scutum with one smooth and slender median spine. Free sternites of abdomen and surface of 1st to 4th coxae bright and smooth, edge of small humps of marginal rows of coxae straightly blunted. 1st article of chelicerae smooth dorsally. Palps : femur ventrally with 4-5 scattered and very small teeth, patella without an apophysis, and together with tibia and tarsus unarmed, tibia $3\frac{1}{2}$ times longer than broad, tarsus in male with a ventral longitudinal row of very small teeth. Legs : trochanters and femora almost smooth, very sparsely scattered with small teeth ; number of noduli on 1st to 4th femora 2-7-2-3.

Colour of body dorsally and ventrally and of 1st to 4th coxae dark brown to blackish-brown ; ocular tubercle bright black with a lighter longitudinal furrow. Female somewhat lighter brown than the male ; carapace on each side of the ocular tubercle and scutum on each side of median spine (sometimes also in front) scattered with small granules of white secretions. Chelicerae and palps pale yellow ; legs blackish-brown.

Distribution.—Coonoor Ghat, alt. 5700-6000 feet (3 males, 2 females—Graveley leg. : Types) ; Ootacamund, alt. 6700-8000 feet (4 males—Graveley leg.) ; Nilgiris.

Type-specimens.—No. $\frac{1028}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Zaleptus Thor.

1876. *Zaleptus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, IX, p. 115.
1923. *Zaleptus*, Roewer, *Weberknechte der Erde*, p. 1036.

Key to the Continental species of the genus *Zaleptus*.

- | | |
|--|----------------------------------|
| 1. Patella of palps without a median apophysis .. | 2 |
| Patella of palps with a median apophysis .. | 4 |
| 2. Ocular tubercle wholly smooth .. | 3 |
| Ocular tubercle toothed or granulated above .. | |
| (India) | <i>Z. thorellii</i> , p. 148. |
| 3. Femur and tibia of palps toothed (Malacca) .. | <i>Z. cinctus</i> , p. 149. |
| Palps wholly smooth, unarmed (Palni Hills) .. | <i>Z. indicus</i> , p. 149. |
| 4. 1st article of chelicerae dorsally toothed .. | 5 |
| 1st article of chelicerae dorsally smooth .. | 8 |
| 5. 2nd and 4th tibiae each with one broad whitish apical ring-spot .. | 6 |
| 1st to 4th tibiae uniformly coloured, without pale apical rings .. | 7 |
| 6. Abdomen dorsally with two parallel longitudinal rows of golden-yellowish spots (Siam) .. | <i>Z. biserialatus</i> , p. 148. |
| Abdomen dorsally uniformly coloured pale-brown, only 1st to 3rd free tergites each with a pair of white spots (Burma) .. | <i>Z. festivus</i> , p. 148. |

7. Humps of the marginal rows of 1st to 4th coxae three-pointed (Siam) *Z. spinosus*, p. 148.
 Humps of the marginal rows of 1st to 4th coxae straightly blunted (Tenasserim) *Z. sulphureus*, p. 148.
 8. Ocular tubercle granulated above (Malacca) *Z. unicolor*, p. 140.
 Ocular tubercle wholly smooth above 9
 9. 2nd and 4th tibiae each with one broad whitish apical ring-spot 10
 1st to 4th tibiae uniformly coloured, without pale apical rings 11
 10. Femur of palps ventrally toothed; body with metallic coppery or golden gloss (Tenasserim, Malacca) *Z. subcupreus*, p. 149.
 Femur of palps unarmed; body with a metallic green gloss (Nilgiris) *Z. viridis*, p. 150.
 11. Femur of palps ventrally bluntly toothed; 1st to 4th trochanters black or metallic-blue, each with two white spots (Sikkim) *Z. splendens*, p. 149.
 Femur of palps unarmed; 1st to 4th trochanters uniform black (Sikkim) *Z. caeruleus*, p. 148.

Zaleptus thorellii With.

1903. *Zaleptus thorellii*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 480.

1923. *Zaleptus thorellii*, Roewer, *Weberknechte der Erde*, p. 1037.

Distribution.—Birbhum District, India.

Zaleptus caeruleus Rwr.

1910. *Zaleptus caeruleus*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 134.

1923. *Zaleptus caeruleus*, Roewer, *Weberknechte der Erde*, p. 1037.

Distribution.—Sikkim.

Zaleptus spinosus Rwr.

1910. *Zaleptus spinosus*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 135.

1923. *Zaleptus spinosus*, Roewer, *Weberknechte der Erde*, p. 1038.

Distribution.—Dawna Hills, Burma; Bangkok, Siam.

Zaleptus biseriatus Rwr.

1910. *Zaleptus biseriatus*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 135.

1923. *Zaleptus biseriatus*, Roewer, *Weberknechte der Erde*, p. 1039.

Distribution.—Bangkok, Siam.

Zaleptus festivus Thor.

1889. *Zaleptus festivus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 611.

1923. *Zaleptus festivus*, Roewer, *Weberknechte der Erde*, p. 1039.

Distribution.—Kawkareit, Tenasserim, Dawna Hills, Burma; Bao Laos, Siam.

*** Zaleptus sulphureus Thor.**

1889. *Zaleptus sulphureus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 614.

1903. *Zaleptus sulphureus*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 479.

1923. *Zaleptus sulphureus*, Roewer, *Weberknechte der Erde*, p. 1040, fig. 1141.

Distribution.—Abor Country, Assam; Tenasserim, Dawna Hills, Burma. Represented in this collection from: Heho River (12 males), Fort Stedman (1 male), Foot of Elephant Hill, near Yawngnaw (32 males and females—Gravelly leg.; on bushes, very active and easily disturbed); Southern Shan States, Burma.

*** *Zaleptus splendens* Rwr.**

1911. *Zaleptus splendens*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, p. 170.

1923. *Zaleptus splendens*, Roewer, *Weberknechte der Erde*, p. 1038.

Distribution.—Ghoom, alt. 4000-5000 feet, Darjeeling District (1 male, 2 females—Carmichael leg.); Sureil, alt. 5000 feet, Darjeeling District (1 male, 2 females).

*** *Zaleptus indicus*, sp. nov.**

Length of body 3, 1st to 4th femora 7.5, 14, 6.5, 11, 1st to 4th legs 37, 65, 35, 51 mm.

Surface of carapace, scutum and free tergites and sternites of abdomen uniformly and finely shagreened; ocular tubercle all over bright and smooth, entirely unarmed. Surface of 1st to 4th coxae coarsely granulated, edge of small humps of marginal rows of coxae straightly blunted. 1st article of chelicerae smooth dorsally. Palps: femur, patella, tibia and tarsus unarmed, patella without an apophysis, tibia $2\frac{1}{2}$ times longer than broad, tarsus in male with a ventral longitudinal row of very small teeth. Legs: femora toothed, number of noduli of 1st to 4th femora 0-1-0-0.

Colour of the body dorsally and ventrally and chelicerae, palps and legs entirely ferruginous, ocular tubercle only bright black.

Distribution.—Kodaikanal, Palni Hills, South India (2 males, 1 pullus—Kemp leg.; Types).

Type-specimens.—No. $\frac{1063}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

***Zaleptus subcupreus* Thor.**

1889. *Zaleptus subcupreus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 609.

1923. *Zaleptus subcupreus*, Roewer, *Weberknechte der Erde*, p. 1040.

Distribution.—Tenasserim; Pegu; Burma; and Malacca.

***Zaleptus cinctus* Rwr.**

1923. *Zaleptus cinctus*, Roewer, *Weberknechte der Erde*, p. 1041.

Distribution.—Malacca.

***Zaleptus unicolor* Rwr.**

1923. *Zaleptus unicolor*, Roewer, *Weberknechte der Erde*, p. 1041.

Distribution.—Malacca.

Zaleptus viridis Rwr.

The diagnosis of this new species, which was collected by Dr. J. Carl of Geneva in South India in 1926, will be published this year in *Revue Suisse de Zoologie*.

Ceratobunellus Rwr.

1911. *Ceratobunellus*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, p. 175

1923. *Ceratobunellus*, Roewer, *Weberknechte der Erde*, p. 1051.

Key to the species of the genus *Ceratobunellus*.

- Body black-brown; scutum with two posterior ferruginous spots (Calcutta) *C. calcuttensis*.
 Body pale-ferruginous; scutum with two longitudinal rows of black spots with a median pale-yellow band running between them (Calcutta) *C. brevipes*.

***Ceratobunellus calcuttensis* (With).**

1903. *Ceratobunus calcuttensis*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 477.

1923. *Ceratobunellus calcuttensis*, Roewer, *Weberknechte der Erde*, p. 1051.

Distribution.—Calcutta, Bengal, India.

***Ceratobunellus brevipes* (With).**

1903. *Ceratobunus brevipes*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 478.

1923. *Ceratobunellus brevipes*, Roewer, *Weberknechte der Erde*, p. 1051.

Distribution.—Calcutta, Bengal, India.

***Verpulus* Sim.**

1901. *Verpulus*, Simon, *Proc. Zool. Soc. London*, II, p. 84.

1923. *Verpulus*, Roewer, *Weberknechte der Erde*, p. 1056.

Key to the species of the genus *Verpulus*.

- Ocular tubercle wholly smooth (Malacca) .. *V. spumatus*.
 Ocular tubercle uniformly granulated (Burma) .. *V. marginatus*.

***Verpulus spumatus* Sim.**

1901. *Verpulus spumatus*, Simon, *Proc. Zool. Soc. London*, II, p. 84.

1923. *Verpulus spumatus*, Roewer, *Weberknechte der Erde*, p. 1056.

Distribution.—Bukit Besar, Singapore, Malacca.

***Verpulus marginatus* Rwr.**

1912. *Verpulus marginatus*, Roewer, *Arch., Naturg.*, LXXVIII, fasc. 1, p. 52.

1923. *Verpulus marginatus*, Roewer, *Weberknechte der Erde*, p. 1056.

Distribution.—Dawna Hills, Burma.

Hypsibunus Thor.1891. *Hypsibunus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXX, p. 679.1923. *Hypsibunus*, Roewer, *Weberknechte der Erde*, p. 1052.Key to the Continental species of the genus *Hypsibunus*.

- 1st article of chelicerae dorsally toothed; ocular
tubercle with a ring of pointed teeth around each
eye (Annam) *H. scaber*.
1st article of chelicerae dorsally smooth; ocular
tubercle only frontally with a few teeth
(Calcutta) *H. fuscus*.

Hypsibunus scaber Rwr.1910. *Hypsibunus scaber*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 149.1923. *Hypsibunus scaber*, Roewer, *Weberknechte der Erde*, p. 1053.*Distribution*.—Annam.**Hypsibunus fuscus (With).**1903. *Zaleptus fuscus*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 479.1923. *Hypsibunus fuscus*, Roewer, *Weberknechte der Erde*, p. 1054.*Distribution*.—Calcutta, Bengal, India.**Tetraceratobunus Rwr.**1915. *Tetraceratobunus*, Roewer, *Arch. Naturg.*, LXXXI, fasc. 3, p. 150.1923. *Tetraceratobunus*, Roewer, *Weberknechte der Erde*, p. 1055.

Only one species of this genus has so far been described.

Tetraceratobunus lineatus Rwr.1915. *Tetraceratobunus lineatus*, Roewer, *Arch. Naturg.*, LXXXI, fasc. 3, p. 151.1923. *Tetraceratobunus lineatus*, Roewer, *Weberknechte der Erde*, p. 1055.*Distribution*.—Darjeeling, Bengal.**Euceratobunus Rwr.**1923. *Euceratobunus*, Roewer, *Weberknechte der Erde*, p. 1052.

Only a single species of this genus is known.

Euceratobunus pulcher (With).1903. *Ceratobunus pulcher*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 476.1923. *Euceratobunus pulcher*, Roewer, *Weberknechte der Erde*, p. 1052.*Distribution*.—Punkabari, Assam, India.**Kempina Rwr.**1911. *Kempina*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, p. 177.1923. *Kempina*, Roewer, *Weberknechte der Erde*, p. 1054.Key to the species of the genus *Kempina*.

- Humps of marginal rows of 1st to 4th coxae
straightly blunted (Assam) *K. bicornigera*.
Humps of marginal rows of 1st to 4th coxae three-
pointed (Burma) *K. cuprea*.

Kempina bicornigera Rwr.

1911. *Kempina bicornigera*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, p. 177.
 1923. *Kempina bicornigera*, Roewer, *Weberknechte der Erde*, p. 1054.

Distribution.—Mangaldai District, Assam ; Bhutan.

Kempina cuprea Rwr.

1912. *Kempina cuprea*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 61.
 1923. *Kempina cuprea*, Roewer, *Weberknechte der Erde*, p. 1055.

Distribution.—Dawna Hills, Burma.

Euzaleptus Rwr.

1911. *Euzaleptus*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, pp. 179 and 182
 1923. *Euzaleptus*, Roewer, *Weberknechte der Erde*, p. 1045.

Three Continental species and one species from Borneo.

Key to the Continental species of the genus *Euzaleptus*.

- | | | |
|---|---------------------|---|
| 1. 1st article of chelicerae dorsally smooth .. | | 2 |
| 1st article of chelicerae dorsally toothed (Sikkim) | <i>E. muticus</i> . | |
| 2. Body and legs distinctly hirsute (Sikkim) .. | <i>E. pilosus</i> . | |
| Body and legs not hirsute (Sikkim) .. | <i>E. minutus</i> . | |

Euzaleptus minutus (With).

1903. *Zaleptus minutus*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 481.
 1923. *Euzaleptus minutus*, Roewer, *Weberknechte der Erde*, p. 1045.

Distribution.—Darjeeling, Bengal.

*** Euzaleptus pilosus, sp. nov.**

Male : length of body 3, 1st to 4th femora 4.5, 7, 3.5, 5, 1st to 4th legs 18, 37, 19, 25 mm.

Female : length of body 5, 1st to 4th femora 4, 7, 3.5, 5, 1st to 4th legs 18, 37, 19, 25 mm.

Surface of carapace, scutum and free tergites and sternites of abdomen and 1st to 4th coxae very finely and densely uniformly granulated and hirsute ; ocular tubercle within and on each side of its longitudinal furrow and basally similarly granulated. Edge of small humps of marginal rows of 1st to 4th coxae straightly blunted. 1st article of chelicerae smooth dorsally. Palps : femur, patella and tibia all over densely and finely granulated, patella without an apophysis, tibia 3 times longer than broad, tarsus smooth, but in male with a ventral longitudinal row of small teeth. Legs : trochanters granulated like the body, femora toothed and covered with prominent hairs ; number of noduli on 1st to 4th femora 0.3-0-1.

Colour of body black or blackish-brown, the two thoracic tergites, the area of scutum and free tergites of the abdomen each with one row of six whitish-yellow minute spots. Chelicerae pale yellow ; palps and trochanters of the legs pale yellow, but their granules black ; rest of the legs reddish-brown.

Remarks.—This species appears very similar to *Metaverpulus hirsutus* Rwr., vide p. 155.

Distribution.—Kalimpong, Darjeeling District (2 males, 1 female, 2 pulli).

Type-specimens.—No. $\frac{1045}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

*** *Euzaleptus muticus*, sp. nov.**

Length of body 3.5 (male), 4 (female), 1st to 4th femora 5.5, 10, 4.5, 8, 1st to 4th legs 25, 50, 26, 36 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly and coarsely granulated, scutum with one median longitudinal shagreened spot; ocular tubercle wholly smooth. Free sternites of abdomen smooth; surface of 1st to 4th coxae very sparsely but coarsely granulated, edge of small humps of marginal rows of coxae straightly blunted. 1st article of chelicerae dorsally with 34 small teeth. Palps: femur ventrally sparsely toothed, patella without an apophysis, dorsally sparsely toothed, tibia 3 times longer than broad, ventrally and on each side sparsely but strongly toothed, tarsus unarmed, but in male with a ventral longitudinal row of very small teeth. Legs: trochanters smooth, femora sparsely toothed; number of noduli on 1st to 4th femora 0.3-0.1.

Colour of body entirely black in male and blackish-brown in female, carapace in front and on each side of the black ocular tubercle with scattered spots and covered on these spots with white secretions. Coxae black, covered in their apical halves with white secretions. Chelicerae and area around the mouth pale ferruginous; palps dark brown, tarsus only pale yellow. Legs dark brown, with black trochanters.

Distribution.—Darjeeling, alt. 7000 feet (4 males, 2 females—Gravely leg.; Types and cotypes).

Type-specimens.—No. $\frac{1043}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

***Zaleptanus*, gen. nov.**

Ocular tubercle as long as broad, as high, unarmed, without large spines or thorns. Scutum of abdomen entirely unarmed. Edge of small humps of marginal rows of 1st to 4th coxae straightly blunted. Legs long and thin, 1st to 4th femora much longer than twice the length of body; number of noduli on 1st to 4th femora 0.2-0.0.

*** *Zaleptanus gravelyi*, sp. nov.**

Length of body 5 (male), 6 (female), 1st to 4th femora 13, 26, 12, 16, 1st to 4th legs 70, 135, 60, 115 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly and finely granulated; ocular tubercle entirely smooth all over. Free sternites of abdomen each with one row of small granules; surface of 1st to 4th coxae very coarsely granulated, edge of small humps of marginal rows of 1st to 4th coxae straightly blunted. 1st article of chelicerae

dorsally smooth. Palps: femur ventrally densely toothed, patella toothed all over, without an apophysis, tibia $3\frac{1}{2}$ times longer than broad, unarmed and smooth, tarsus smooth, but in male with a ventral longitudinal row of very small teeth. Legs very long and thin, femora toothed, number of noduli on 1st to 4th femora 0-2-0-0.

Colour of body dorsally and ventrally and ocular tubercle blackish-brown; 1st to 4th coxae partly covered with white secretions. Chelicerae and palps uniform pale yellow; legs uniform dark brown.

Distribution.—Parambikulam, alt. 1700-3200 feet (4 males, 5 females, 5 *pulli*—Gravely *leg.*); Forest Tramway mile, alt. 300 feet (3 males, 1 female, 8 *pulli*—Gravely *leg.*); Kavalai, alt. 1300-3000 feet (3 males, 4 females, 7 *pulli*—Gravely *leg.*); Cochin State.

Type-specimens.—No. $\frac{1040}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Cervibunus Rwr.

1912. *Cervibunus*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 51.

1923. *Cervibunus*, Roewer, *Weberknechte der Erde*, p. 1046.

Key to the species of the genus *Cervibunus*.

- The four thorns of ocular tubercle slender; each forked on its tip; 1st article of chelicerae dorsally densely toothed (Burma) *C. maculatus*.
 The four thorns of ocular tubercle short and curved, not forked at the tip; 1st article of chelicerae dorsally almost smooth (Bengal) *C. ornatus*.

Cervibunus maculatus Rwr.

1912. *Cervibunus maculatus*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 52.

1923. *Cervibunus maculatus*, Roewer, *Weberknechte der Erde*, p. 1046.

Distribution.—Dawna Hills, Burma.

*** *Cervibunus ornatus*, sp. nov.**

(Fig. 8).

Length of body 5, 1st to 4th femora 7, 14, 6.5, 9, 1st to 4th legs 28, 72, 26, 39 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly granulated; ocular tubercle granulated and dorsally on each side with one anterior and one posterior erect and somewhat curved spine (*i.e.*



FIG. 8.—*Cervibunus ornatus*, sp. nov.—(a) Left lateral view of ocular tubercle; (b) two small humps of the marginal rows of the coxae.

four spines in all). Free sternites of abdomen each with one row of small granules; surface of 1st to 4th coxae coarsely granulated, edge of

small humps of marginal rows of coxae three-pointed. 1st article of chelicerae dorsally with 2-3 small teeth. Palps : femur ventrally with stouter and dorsally with finer teeth, patella toothed all over, medially with a toothed apical apophysis ; tibia 3 times longer than broad, toothed all over ; tarsus unarmed and smooth. Legs : femora toothed ; number of noduli on 1st to 4th femora 0-3-0-0.

Colour of body reddish-brown, carapace in front and on each side of the blackish-brown ocular tubercle scattered with yellow and covered with white secretions ; scutum with one median and two lateral yellowish longitudinal bands, one on each side ; these three bands partly covered with white secretions and the median one continued over the free tergites as small yellowish median spots. Free sternites of abdomen and 1st to 4th coxae covered with a few white secretions. Chelicerae pale yellow ; palps reddish-brown, but the tarsus pale yellow. Legs uniformly reddish-brown, but basal parts of femora and the whole trochanters blackish-brown.

Distribution.—Rangamati, Chittagong, Bengal (1 female—Hodgart leg. ; Type).

Type-specimen.—No. $\frac{1039}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Metazaleptus Rwr.

1912. *Metazaleptus*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 55.

1923. *Metazaleptus*, Roewer, *Weberknechte der Erde*, p. 1044.

Only one species of this genus has so far been discovered.

*** Metazaleptus hirsutus (With).**

1903. *Zaleptus hirsutus*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 482.

1923. *Metazaleptus hirsutus*, Roewer, *Weberknechte der Erde*, p. 1044.

Distribution.—Sureil, alt. 5000 feet (3 males, 7 females), Ghumti, alt. 5000 feet (1 male, 1 female—Garmichael leg.), Lebong, alt. 6000-6600 feet (1 male, 1 female—Gravelly leg.), Kalimpong, alt. 4500 feet (1 male—Gravelly leg.), Darjeeling District, alt. 1000 feet (1 female—Gravelly leg.), Darjeeling District, Bengal.

Metaverpulus Rwr.

1912. *Metaverpulus*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 53.

1923. *Metaverpulus*, Roewer, *Weberknechte der Erde*, p. 1057.

Only one species of this genus has so far been described.

*** Metaverpulus hirsutus Rwr.**

1912. *Metaverpulus hirsutus*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 53.

1923. *Metaverpulus hirsutus*, Roewer, *Weberknechte der Erde*, p. 1057.

The two females possess a medio-apical apophysis on the patella of the palps, the males have none. The number of noduli on 1st to 4th femora of the legs in the *pulli* is 1-4-1-2, but in the adults the same as in the type: 0-4-0-1.

Distribution—Cuttack, Orissa. In this collection represented from: Sitong Ridge, alt. 4700 feet (2 males, 1 female—Gravely leg.); Pashok (5 pulli), Darjeeling District.

Harmanda Rwr.

1910. *Harmanda*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 151.

1923. *Harmanda*, Roewer, *Weberknechte der Erde*, p. 1057.

Key to the species of the genus *Harmanda*.

1. Humps of frontal marginal row of 1st coxa three-pointed; scutum with a metallic gloss (Eastern Himalayas) *H. aenescens*, p. 156.
- Humps of frontal marginal row of 1st coxa straightly blunted; scutum without metallic gloss 2
2. Scutum with three parallel longitudinal rows of golden-yellow spots (Malacca) *H. triseriata*, p. 157.
- Scutum without such rows, at the most with one paler median band 3
3. Legs uniform black, only 1st to 4th trochanters and bases of 1st to 4th femora ferruginous (Sikkim) *H. albipunctata*, p. 156.
- Legs pale and annulated dark-brown 4
4. Scutum with a pale median band 5
- Scutum without a median band, but transversely mottled with small darker spots (Western Himalayas) *H. annulata*, p. 157.
5. Ocular tubercle entirely smooth; tibia of palps unarmed (Eastern Himalayas) *H. lineata*, p. 156.
- Ocular tubercle toothed above; tibia of palps toothed (Sikkim) *H. instructa*, p. 156.

Harmanda albipunctata Rwr.

1915 *Harmandella albipunctata*, Roewer, *Arch. Naturg.*, LXXXI, fasc. 3, p. 148.

1923. *Harmanda albipunctata*, Roewer, *Weberknechte der Erde*, p. 1058.

Distribution.—Darjeeling.

Harmanda aenescens Rwr.

1911. *Harmandella albipunctata*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, p. 172.

1923. *Harmanda aenescens*, Roewer, *Weberknechte der Erde*, p. 1059.

Distribution.—Mussoorie, Western Himalayas; Gowchar, Nepal.

* *Harmanda instructa* Rwr.

1910. *Harmanda instructa*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 154.

1923. *Harmanda instructa*, Roewer, *Weberknechte der Erde*, p. 1058.

Distribution.—Kalimpong, alt. 600-4500 feet, Darjeeling District (4 males, 3 females—Gravely leg.).

* *Harmanda lineata* Rwr.

1911. *Harmandella aenescens*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, p. 173.

1923. *Harmanda lineata*, Roewer, *Weberknechte der Erde*, p. 1059.

Distribution.—Kurseong, Eastern Himalayas. Represented in this collection from: Pashok, alt. 2000-3500 feet (21 males, 7 females—

Gravely leg.); Soom, alt. 3000-3500 feet (4 males—Gravely leg.); Darjeeling District.

***Harmanda annulata* Rwr.**

1911. *Harmandella annulata*, Roewer, *Arch. Naturg.*, LXXVII, fasc. 2, p. 174.

1923. *Harmanda annulata*, Roewer, *Weberknechte der Erde*, p. 1059.

Distribution.—Simla, Munduli; Dehra Dun District; Western Himalayas.

***Harmanda triseriata* Rwr.**

1923. *Harmanda triseriata*, Roewer, *Weberknechte der Erde*, p. 1060.

Distribution.—Singapore; Malacca.

***Carmichaelus*, gen. nov.**

Ocular tubercle as broad as long, somewhat higher than long; unarmed, without large spines or thorns. Scutum of abdomen unarmed. Legs long and thin; 1st to 4th femora much longer than body; number of noduli on 1st to 4th femora 1-7-1-2.

*** *Carmichaelus maculatus*, sp. nov.**

(Fig. 9).

Male: length of body 3, 1st to 4th femora 10, 18, 8, 12, 1st to 4th legs 38, 72, 35, 51 mm.

Female: length of body 5, 1st to 4th femora 9, 18, 8, 12, 1st to 4th legs 35, 75, 36, 50 mm.

Surface of carapace, scutum and free tergites of abdomen uniformly shagreened; ocular tubercle as broad as long, $1\frac{1}{2}$ times higher in front than long, unarmed, its median longitudinal furrow shagreened in the same manner as body. Free sternites of abdomen smooth; surface of 1st to 4th coxae coarsely granulated, edge of small humps of marginal rows of coxae bluntly rounded with a small buckle in the middle (fig. 9, b).

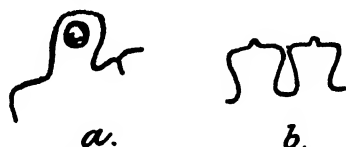


FIG. 9.—*Carmichaelus maculatus*, gen. et sp. nov.—(a) Left lateral view of ocular tubercle; (b) two small humps of the marginal rows of the coxae.

1st article of chelicerae dorsally smooth. Palps: femur ventrally and medially, patella and tibia all over very densely toothed, patella without an apophysis, tibia $3\frac{1}{2}$ times longer than broad, tarsus unarmed, but in male with a longitudinal row of small teeth ventrally. Legs: femora toothed, number of noduli on 1st to 4th femora 1-7-1-2.

Colour of whole body black or blackish-brown, carapace in front and on each side of the black ocular tubercle covered all over with white secretions; scutum with two parallel longitudinal rows of pale yellow spots, which are often thickly covered with white secretions; these spots

are especially prominent on the posterior surface of the abdomen of the female. Free sternites of abdomen and 1st to 4th coxae thickly covered with white secretions. Chelicerae ferruginous; palps dark brown, tarsus pale yellow. Legs uniform blackish-brown.

Distribution.—Birch Hill, alt. 6000-7000 feet, Darjeeling District (2 males, 2 females—Carmichael *leg.*; Types).

Type-specimens.—No. $\frac{1038}{18}$ in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta.

Ceratobunus Thor.

1889. *Ceratobunus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 616.

1923. *Ceratobunus*, Roewer, *Weberknechte der Erde*, p. 1046.

Key to the Continental species of the genus *Ceratobunus*.

- | | |
|---|---------------------------------|
| 1. Humps of marginal rows of 1st to 4th coxae three-pointed | 2 |
| Humps of marginal rows of 1st to 4th coxae straightly blunted | 5 |
| 2. 2nd tibia with a broad white apical ring-spot | 3 |
| 2nd tibia uniformly coloured, without an apical white ring-spot | 4 |
| 3. Patella of palps with a median apophysis (Burma) | <i>C. bimaculatus</i> , p. 158. |
| Patella of palps without a median apophysis (Burma) | <i>C. gravelyi</i> , p. 151. |
| 4. Abdomen dorsally with a metallic blue-green gloss (Burma) | <i>C. T-luteus</i> , p. 159. |
| Abdomen dorsally without a metallic gloss (Burma) | <i>C. annulatus</i> , p. 159. |
| 5. 2nd tibia with a broad white apical ring-spot (India) | <i>C. vigilans</i> , p. 158. |
| 2nd tibia uniformly coloured, without an apical whitish ring-spot (Himalayas) | <i>C. cupreus</i> , p. 158 |

Ceratobunus bimaculatus Thor.

1889. *Ceratobunus bimaculatus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 619.

1923. *Ceratobunus bimaculatus*, Roewer, *Weberknechte der Erde*, p. 1047.

Distribution.—Schwegu, Bhamo, Burma.

Ceratobunus vigilans (With).

1903. *Hypsibunus vigilans*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 475.

1923. *Ceratobunus vigilans*, Roewer, *Weberknechte der Erde*, p. 1049.

Distribution.—Siliguri, Bengal, India.

Ceratobunus cupreus Rwr.

1912. *Ceratobunus cupreus*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 48.

1923. *Ceratobunus cupreus*, Roewer, *Weberknechte der Erde*, p. 1049.

Distribution.—Ghumti, Darjeeling District.

*** *Ceratobunus annulatus* Thor.**

1889. *Ceratobunus annulatus*, Thorell, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 616.

1903. *Ceratobunus annulatus*, With, *Journ. Linn. Soc. London, Zool.*, XXVIII, p. 476.

1928. *Ceratobunus annulatus*, Roewer, *Weberknechte der Erde*, p. 1047.

Distribution.—Mooleyit, Pegu Mudon near Moulmein, Puddupyu, Burma. In this collection represented from: Garo Hills, alt. 3500-3900 feet, Assam (1 male—Kemp *leg.*); Sureil, alt. 5000 feet (3 males, 4 females, 8 *pulli*); Birch Hill (2 females); Lebong, alt. 6000-6600 feet (9 *pulli*); Kalimpong (3 *pulli*), Ghumti, alt. 1500-5000 feet (20 *pulli*); Soom (6 *pulli*); Sitong Ridge, alt. 4700 feet (1 *pullus*); all in Darjeeling District; Nepal Valley (3 males, 1 female; *pulli*).

*** *Ceratobunus gravelyi* Rwr.**

1912. *Ceratobunus gravelyi*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 49.

1923. *Ceratobunus gravelyi*, Roewer, *Weberknechte der Erde*, p. 1050.

Distribution.—Sukli, Misty Hollow, Burma; Rangamati, Chittagong, Bengal (1 male, 3 females—Hodgart *leg.*).

***Ceratobunus T-luteus* Rwr.**

1912. *Ceratobunus T-luteus*, Roewer, *Arch. Naturg.*, LXXVIII, fasc. 1, p. 50.

1923. *Ceratobunus T-luteus*, Roewer, *Weberknechte der Erde*, p. 1050.

Distribution.—Kawkareit, Amherst District, Burma.

***Bastia* Rwr.**

1910. *Bastia*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 156.

1923. *Bastia*, Roewer, *Weberknechte der Erde*, p. 1062.

Only one species.

***Bastia lineata* Rwr.**

1910. *Bastia lineata*, Roewer, *Abh. Ver. Hamburg*, XIX, fasc. 4, p. 156.

1923. *Bastia lineata*, Roewer, *Weberknechte der Erde*, p. 1062.

Distribution.—Maria Basti, India.

Subfamily PHALANGIINAE Sim.

As is stated in the introductory part all the specimens of this subfamily are young specimens which it is not possible to determine generically.

Distribution.—Mount Godwin-Austen (1 *pullus*); Central Gilgit (2 *pulli*); both in Himalayas; Kashmir Valley, alt. 7000-9000 feet (1 *pullus*).

THE FISH OF THE INDAWGYI LAKE AND THE STREAMS OF THE MYITKYINA DISTRICT (UPPER BURMA).

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(Plates VII—X.)

INTRODUCTION.

The following report on the fishes of the Indawgyi Lake and the streams of the Myitkyina District, Upper Burma, is based on a large collection made by a party of the Zoological Survey of India under the leadership of Dr. B. N. Chopra during October to December, 1926. One of the species of the genus *Danio*, subgenus *Brachydanio*, out of this collection has already been described by Dr. S. L. Hora,¹ while the collection of the various species of the genus *Nemachilus* is being studied by him and a report on it will be published separately in his revision of the Indian species of the genus.

We have to record here our great indebtedness to our colleague Dr. B. N. Chopra for the great care he took in making the collection and for the excellent preservation of the material obtained. He also collected detailed information about the local names of the fish and made careful records of their natural colouration in the field-book. We have drawn largely on his notes about the physical characters of the lake, etc., and have also to thank him for other information ungrudgingly given at all times. The illustrations accompanying this paper were executed under our supervision by Babu A. C. Chowdhury and Babu D. N. Bagchi, two of the talented artists of the Zoological Survey, and we are indebted to them for the excellent delineations of the species figured.

In addition to the Indawgyi Lake the collections of fish under report were made from (1) several small pools and sluggish muddy streams, all of which are directly or indirectly connected with the lake, (2) large rivers or *chaungs*² also directly or indirectly connected with the lake, (3) pools and streams in the Myitkyina District not connected with the lake, and (4) rocky and hill-streams in the same district. We give below the lists of species collected from these areas :—

I. Indawgyi Lake.

| | |
|--|---|
| <i>Amphipnous cuchia</i> (Ham. Buch.). | <i>Barbus chola</i> (Ham. Buch.). |
| <i>Clarias batrachus</i> (Linn.). | <i>Barbus phutunio</i> (Ham. Buch.). |
| <i>Silurus cochinchinensis</i> Cuv. & Val. | <i>Barbus sophore</i> (Ham. Buch.). |
| <i>Amblyceps horae</i> , sp. nov. | <i>Rasbora daniconius</i> (Ham. Buch.). |
| <i>Saccobranchius fossilis</i> (Bloch). | <i>Rasbora rasbora</i> (Ham. Buch.). |
| <i>Wallago attu</i> (Bloch). | <i>Rohtee feae</i> (Vincig.). |

¹ Hora, S. L., *Rec. Ind. Mus.*, XXX, p. 39, fig. 2 (1928).

² *Chaung* is the Burmese name for a big stream or river.

- | | |
|--|---|
| <i>Eutropiichthys vacha</i> (Ham. Buch.). | <i>Rohitee alfrediana</i> (Cuv. & Val.). |
| <i>Callichrous pabo</i> (Ham. Buch.). | <i>Rohitee belangeri</i> (Cuv. & Val.). |
| <i>Aoria aor</i> (Ham. Buch.). | <i>Larubuca</i> (<i>Larubuca</i>) <i>larubuca</i> (Ham. Buch.). |
| <i>Aoria gulio</i> (Ham. Buch.). | <i>Notopterus notopterus</i> (Pallas). |
| <i>Aoria cavasius</i> (Ham. Buch.). | <i>Ambassis ranga</i> (Ham. Buch.). |
| <i>Aoria</i> (<i>Macronoides</i>) <i>dayi</i> (Vincig.). | <i>Ambassis baculis</i> (Ham. Buch.). |
| <i>Akysis variegatus</i> subsp. <i>variegatus</i> , nov. | <i>Mastacembelus armatus</i> (Lacép.). |
| <i>Erethistes conta</i> (Ham. Buch.). | <i>Ophicephalus marulius</i> Ham. Buch. |
| <i>Lepidocephalichthys berdmorei</i> (Blyth). | <i>Ophicephalus striatus</i> Bloch. |
| <i>Labeo calbasu</i> (Ham. Buch.). | <i>Ophicephalus gachua</i> Ham. Buch. |
| <i>Labeo goniis</i> (Ham. Buch.). | <i>Ophicephalus punctatus</i> Bloch. |
| <i>Labeo rohita</i> (Ham. Buch.). | <i>Anabas testudineus</i> (Bloch). |
| <i>Catla catla</i> (Ham. Buch.). | <i>Trichogaster fasciatus</i> Bl. Schn. |
| <i>Barbus sewelli</i> , sp. nov. | <i>Indostomus paradoxus</i> , gen. et sp. nov. |
| <i>Barbus myitkyinae</i> , sp. nov. | <i>Tetraodon cutcutia</i> Ham. Buch. |
| <i>Barbus sarana caudimarginatus</i> Blyth. | |

II. Small pools and sluggish muddy streams directly or indirectly connected with the Indawgyi Lake.

- | | |
|---|---|
| <i>Amphipnous cuchia</i> (Ham. Buch.). | <i>Xenentodon cancila</i> (Ham. Buch.). |
| <i>Clarias batrachus</i> (Linn.). | <i>Ambassis ranga</i> (Ham. Buch.). |
| <i>Lepidocephalichthys guntea</i> (Ham. Buch.). | <i>Ambassis baculis</i> (Ham. Buch.). |
| <i>Lepidocephalichthys berdmorei</i> (Blyth). | <i>Radis badis</i> (Ham. Buch.). |
| <i>Barbus chola</i> (Ham. Buch.). | <i>Badis dario</i> (Ham. Buch.). |
| <i>Barbus phutunio</i> (Ham. Buch.). | <i>Ophicephalus gachua</i> Ham. Buch. |
| <i>Rasbora daniconius</i> (Ham. Buch.). | <i>Ophicephalus punctatus</i> Bloch. |
| <i>Gudusia variegata</i> (Day). | <i>Anabas testudineus</i> (Bloch). |
| | <i>Tetraodon cutcutia</i> Ham. Buch. |

The 17 species from the small pools and sluggish streams, with the exception of *Lepidocephalichthys guntea*, *Gudusia variegata*, *Xenentodon cancila*, *Badis badis* and *Badis dario*, were also found in the lake. *G. variegata* and *X. cancila* probably visit the lake from time to time, while the two perches of the genus *Badis* appear to be mostly confined to muddy and hill streams.

III. Large rivers and Chaungs directly or indirectly connected with the Indawgyi Lake.

- | | |
|---|---|
| <i>Monopterus albus</i> (Zuiew). | <i>Amblypharyngodon atkinsonii</i> (Blyth). |
| <i>Saccobranchius fossilis</i> (Bloch). | <i>Barbus chagunio</i> (Ham. Buch.). |
| <i>Eutropiichthys vacha</i> (Ham. Buch.). | <i>Barbus hexastichus</i> McClell. |
| <i>Callichrous pabo</i> (Ham. Buch.). | <i>Barbus chola</i> (Ham. Buch.). |
| <i>Callichrous pabda</i> (Ham. Buch.). | |

| | |
|---|---|
| <i>Pseudeutropius taakree</i> (Sykes). | <i>Barbus phutunio</i> (Ham. Buch.). |
| <i>Aoria leucophasis</i> (Blyth). | <i>Esomus altus</i> (Blyth). |
| <i>Bagarius bagarius</i> (Ham. Buch.). | <i>Rasbora daniconius</i> (Ham. Buch.). |
| <i>Labeo rohita</i> (Ham. Buch.). | <i>Rohtee feae</i> (Vincig.). |
| <i>Labeo angra</i> (Ham. Buch.). | <i>Barilius guttatus</i> Day. |
| <i>Labeo boga</i> (Ham. Buch.). | <i>Chela sladeni</i> Day. |
| <i>Gudusia variegata</i> (Day). | <i>Ophicephalus marulius</i> Ham. Buch. |
| <i>Notopterus notopterus</i> (Pallas). | <i>Ophicephalus striatus</i> Bloch. |
| <i>Xenentodon cancila</i> (Ham. Buch.). | <i>Ophicephalus gachua</i> Ham. Buch. |
| <i>Mastacembelus armatus</i> (Lacép.). | <i>Doryichthys dünckeri</i> , sp. nov. |
| <i>Chaudhuria caudata</i> Annand. | <i>Tetraodon cutcutia</i> Ham. Buch. |
| <i>Cirrhitina mrigala</i> (Ham. Buch.). | |

Of the 32 species enumerated above, *Monopterus albus*, *Callichrous pabda*, *Pseudeutropius taakree*, *Aoria leucophasis*, *Bagarius bagarius*, *Labeo angra*, *Labeo boga*, *Cirrhitina mrigala*, *Amblypharyngodon atkinsonii*, *Barbus chagunio*, *Barbus hexastichus*, *Esomus altus*, *Barilius guttatus*, *Chela sladeni*, *Gudusia variegata*, *Xenentodon cancila*, *Chaudhuria caudata*, *Doryichthys dünckeri*, were not found in the lake. The occurrence of *Chaudhuria caudata*, which was known so far only from the Inlé Lake, S. Shan States, in this area is of special interest, but with only a single specimen, which we provisionally assign to this species, it would not be right to dilate on the discontinuous distribution of this peculiar form in the S. Shan States on the one hand and in Upper Burma on the other. The other species, with the exception of *Doryichthys dünckeri*, are all widely distributed in the rivers of India or Burma, and do not call for any special remarks. The occurrence of a species of the genus *Doryichthys* in inland waters so far away from the sea and above the zone of tidal influence is of special interest.

IV. Small pools and streams not connected with the Indawgyi Lake.

| | |
|---|---|
| <i>Silurus cochinchinensis</i> Cuv. & Val. | <i>Barbus phutunio</i> (Ham. Buch.). |
| <i>Aoria cavasius</i> (Ham. Buch.). | <i>Barbus sophore</i> (Ham. Buch.). |
| <i>Aoria pulcher</i> (Chaudhuri). | <i>Danio aequipinnatus</i> (McClell.). |
| <i>Lepidocephalichthys guntea</i> (Ham. Buch.). | <i>Danio (Bachydanio) rerio</i> (Ham. Buch.). |
| <i>Lepidocephalichthys berdmorei</i> (Blyth). | <i>Badis badis</i> (Ham. Buch.). |
| <i>Chopraia rupicola</i> , gen. et sp. nov. | <i>Badis dario</i> (Ham. Buch.). |
| <i>Barbus hexastichus</i> McClell. | <i>Ophicephalus gachua</i> Ham. Buch. |
| | <i>Parasphaerichthys ocellatus</i> , gen. et sp. nov. |
| | <i>Trichogaster fasciatus</i> Bl. Schn. |

Of the 16 species from the small pools and streams not connected with the Indawgyi Lake, *Chopraia rupicola* and *Parasphaerichthys ocellatus* are both new rupicolous forms and are apparently endemic in the area; the former of these was also collected from the hill-streams in the same district. The new genus of the family Anabantidae, which

we have described as *Parasphaerichthys*, is of special interest. It is, as the name indicates, closely allied to the genus *Sphaerichthys* Canestrini¹ which occurs in the Malay Peninsula and the Dutch Indies.

V. Rocky and hill-streams of the Myitkyina District.

| | |
|--|--|
| <i>Aoria (Macronoides) dayi</i> (Vincig.). | <i>Lepidocephalichthys bermorei</i> (Blyth). |
| <i>Akysis variegatus</i> subsp. <i>variegatus</i> , nov. | <i>Acanthopthalmus pangia</i> (Ham. Buch.). |
| <i>Glyptothorax tuberculatus</i> , sp. nov. | <i>Danio aequipinnatus</i> (McClell.). |
| <i>Glyptothorax burmanicus</i> , sp. nov. | <i>Danio (Brachydanio) rerio</i> (Ham. Buch.). |
| <i>Balitora brucei</i> Gray. | <i>Danio (Brachydanio) choprae</i> Hora. |
| <i>Chopraia rupicola</i> , gen. et sp. nov. | <i>Ambassis ranga</i> (Ham. Buch.). |
| <i>Garra lamta</i> (Ham. Buch.). | <i>Badis badis</i> (Ham. Buch.). |
| <i>Barbus phutunio</i> (Ham. Buch.). | <i>Badis dario</i> (Ham. Buch.). |
| <i>Barbus burmanicus</i> Day. | <i>Ophicephalus gachua</i> Ham. Buch. |
| <i>Rasbora daniconius</i> (Ham. Buch.). | |
| <i>Rasbora rasbora</i> (Ham. Buch.). | |

Of these 20 species the Homalopterid *Chopraia rupicola* has been referred to above and the only two forms to which attention may be drawn are the two new species of the genus *Glyptothorax*. The hill-streams of this district are not very rapid, and none of the fishes of these streams are highly specialised.

In the following table we give a complete list of all the species which were found in the waters of the Myitkyina District including the Indawgyi Lake. In the same table we give the local Burmese names of the fish so far as these could be found out by Dr. Chopra and the Survey party by enquiry from the fishermen.

| Family SYMBRANCHIDÆ. | | Local names. |
|--|----|-------------------------------|
| 1. <i>Amphipnous cuchia</i> (Ham. Buch.) | .. | .. <i>Nga-sin.</i> |
| 2. <i>Monopterus albus</i> (Zuiew) | .. | .. |
| Family SILURIDÆ. | | |
| 3. <i>Clarias batrachus</i> (Linn.) | .. | .. <i>Nga-khu.</i> |
| 4. <i>Silurus cochinchinensis</i> Cuv. & Val. | .. | .. <i>Taung-nga-nu-ithan.</i> |
| 5. <i>Amblyceps horae</i> , sp. nov. | .. | .. |
| 6. <i>Saccobranchius fossilis</i> (Bloch) | .. | .. <i>Nga-khu or Nga-gyi.</i> |
| 7. <i>Wallago attu</i> (Bl. Sohn.) | .. | .. |
| 8. <i>Eutropichthys vacha</i> (Ham. Buch.) | .. | .. <i>Nga-glaung.</i> |
| 9. <i>Callichrous pabda</i> (Ham. Buch.) | .. | .. <i>Nga-nudan.</i> |
| 10. <i>Callichrous pabo</i> (Ham. Buch.) | .. | .. |
| 11. <i>Pseudeutropius taakree</i> (Sykes) | .. | .. <i>Nga-myin-ok-pha.</i> |
| 12. <i>Aoria aor</i> (Ham. Buch.) | .. | .. <i>Nga-gyaung.</i> |
| 13. <i>Aoria gulio</i> (Ham. Buch.) | .. | .. |
| 14. <i>Aoria cavasius</i> (Ham. Buch.) | .. | .. <i>Nga-zin-yaing.</i> |
| 15. <i>Aoria leucophasis</i> (Blyth) | .. | .. <i>Nga-nouk-twa.</i> |
| 16. <i>Aoria pulcher</i> (Chaudhuri) | .. | .. |
| 17. <i>Aoria (Macronoides) dayi</i> (Vincig.) | .. | .. |
| 18. <i>Akysis variegatus</i> subsp. <i>variegatus</i> nov. | .. | .. |
| 19. <i>Bagarius bagarius</i> (Ham. Buch.) | .. | .. <i>Nga-maun-ma.</i> |

¹ Canestrini, J., *Verh. Zool.-bot. Gesellsch. Wien.* X, p. 707 (1860).

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|---|----|----|-------------------|
| 20. <i>Glyptothorax tuberculatus</i> , sp. nov. | .. | .. | |
| 21. <i>Glyptothorax burmanicus</i> , sp. nov. | .. | .. | |
| 22. <i>Erethistes conta</i> (Ham. Buch.) | .. | .. | <i>Ta-nga-ngo</i> |

Family HOMALOPTERIDAE.

- | | | | |
|--|----|----|--|
| 23. <i>Choprasia rupicola</i> , gen. et sp. nov. | .. | .. | |
| 24. <i>Balitora brucei</i> Gray | .. | .. | |

Family COBITIDAE.

- | | | | |
|--|----|----|--|
| 25. <i>Lepidocephalichthys guntea</i> (Ham. Buch.) | .. | .. | |
| 26. <i>Lepidocephalichthys berimorei</i> (Blyth) | .. | .. | |
| 27. <i>Acanthopthalmus pangsa</i> (Ham. Buch.) | .. | .. | |

Family CYPRINIDAE.

- | | | | |
|---|----|----|----------------------------|
| 28. <i>Garra lamta</i> (Ham. Buch.) | .. | .. | |
| 29. <i>Labeo calbasu</i> (Ham. Buch.) | .. | .. | <i>Nga-net pya.</i> |
| 30. <i>Labeo gonius</i> (Ham. Buch.) | .. | .. | <i>Nga-dain.</i> |
| 31. <i>Labeo rohita</i> (Ham. Buch.) | .. | .. | <i>Nga-myichin.</i> |
| 32. <i>Labeo angra</i> (Ham. Buch.) | .. | .. | <i>Kyauk-nga-lu.</i> |
| 33. <i>Labeo boga</i> (Ham. Buch.) | .. | .. | <i>Nga-lu.</i> |
| 34. <i>Cirrhitina mirigala</i> (Ham. Buch.) | .. | .. | <i>Nga-gyin.</i> |
| 35. <i>Calla calla</i> (Ham. Buch.) | .. | .. | <i>Nga-ihine.</i> |
| 36. <i>Amblypharyngodon atkinsonii</i> (Blyth) | .. | .. | <i>Nga-byet.</i> |
| 37. <i>Barbus chagunio</i> (Ham. Buch.) | .. | .. | <i>Nga-balon.</i> |
| 38. <i>Barbus sewelli</i> , sp. nov. | .. | .. | <i>Nga-khon-ma-mee-nee</i> |
| 39. <i>Barbus myitkyinae</i> , sp. nov. | .. | .. | <i>Nga-gyee-gyan.</i> |
| 40. <i>Barbus sarana caudimarginatus</i> Elyth | .. | .. | <i>Nga-khon-ma.</i> |
| 41. <i>Barbus hexastichus</i> McClell. | .. | .. | |
| 42. <i>Barbus chola</i> (Ham. Buch.) | .. | .. | <i>Nga-khon-ma.</i> |
| 43. <i>Barbus burmanicus</i> Day | .. | .. | |
| 44. <i>Barbus phutunio</i> (Ham. Buch.) | .. | .. | |
| 45. <i>Barbus siphore</i> (Ham. Buch.) | .. | .. | <i>Nga-khon-ma-mi-kuet</i> |
| 46. <i>Rasbora alius</i> (Blyth) | .. | .. | |
| 47. <i>Rasbora daniconius</i> (Ham. Buch.) | .. | .. | <i>Nga-na-gyaung.</i> |
| 48. <i>Rasbora rasbora</i> (Ham. Buch.) | .. | .. | |
| 49. <i>Rohitee alfrediana</i> (Cuv. & Val.) | .. | .. | <i>Nga-salam-bya.</i> |
| 50. <i>Rohitee belangeri</i> (Cuv. & Val.) | .. | .. | <i>Nga-phe-awng.</i> |
| 51. <i>Rohitee feae</i> (Vincig.) | .. | .. | <i>Nga-hpa-ma.</i> |
| 52. <i>Barilius guttatus</i> Day | .. | .. | <i>Nga-lawa.</i> |
| 53. <i>Danio aequipinnatus</i> (McClell.) | .. | .. | |
| 54. <i>Danio (Brachydanio) rerio</i> (Ham. Buch.) | .. | .. | |
| 55. <i>Danio (Brachydanio) choprae</i> Hora | .. | .. | |
| 56. <i>Laubuca (Laubuca) laubuca</i> (Ham. Buch.) | .. | .. | |
| 57. <i>Chela sladeni</i> Day | .. | .. | <i>Nga-yin-bounza.</i> |

Family CLUPEIDAE.

- | | | | |
|----------------------------------|----|----|-------------------|
| 55. <i>Gudusia variegata</i> Day | .. | .. | <i>Nga-la-bi.</i> |
|----------------------------------|----|----|-------------------|

Family NOTOPTERIDAE.

- | | | | |
|---|----|----|-----------------|
| 59. <i>Notopterus notopterus</i> (Pallas) | .. | .. | <i>Nga-phe.</i> |
|---|----|----|-----------------|

Family BELONIDAE.

- | | | | |
|--|----|----|-----------------------|
| 60. <i>Xenentodon cancila</i> (Ham. Buch.) | .. | .. | <i>Nga-hpaung-ye.</i> |
|--|----|----|-----------------------|

Family PERCIDAE.

- | | | | |
|--|----|----|---------------------|
| 61. <i>Ambassis ranga</i> (Ham. Buch.) | .. | .. | <i>Nga-zin-zai.</i> |
| 62. <i>Ambassis baculis</i> (Ham. Buch.) | .. | .. | <i>Nga-sin-zai.</i> |

Family NANDIDAE.

- | | | | |
|-------------------------------------|----|----|----|
| 63. <i>Badis badis</i> (Ham. Buch.) | .. | .. | .. |
| 64. <i>Badis dario</i> (Ham. Buch.) | .. | .. | .. |

Family MASTACEMBELIDAE.

65. *Mastacembelus armatus* (Lacép.) *Nga-mwe-do* or *Nga-la-mwe*.

Family CHAUDHURIIDAE.

66. *Chaudhuria caudata* Annand.

Family OPHICEPHALIDAE.

67. *Ophicephalus marulius* Ham. Buch. *Nga-yan-dain*.
 68. *Ophicephalus striatus* Bloch *Nga-yan-ou*.
 69. *Ophicephalus gachua* Ham. Buch. *Nga-yan-pulet*.
 70. *Ophicephalus punctatus* Bloch *Nga-yan*.

Family ANABANTIDAE.

71. *Anabas testudineus* (Bloch) *Nga-byema*.
 72. *Trichogaster fasciatus* Bl. Schn.
 73. *Parasphaerichthys ocellatus*, gen. et sp. nov.

Family INDOSTOMIDAE, nov.

74. *Indostomus paradoxus*, gen. et sp. nov.

Family SYNGNATHIDAE.

75. *Doryichthys dünckeri*, sp. nov.

Family TETRAODONTIDAE.

76. *Tetraodon cutcutia* Ham. Buch. *Nga-zibu*.

For a proper understanding of the fish fauna of the lake it is necessary to preface our remarks with an account of the physical characteristics of the area.

The Indawgyi¹ Lake, the largest freshwater lake of Burma, is situated in the Myitkyina District in Upper Burma, between 25° 5' and 25° 20' North Latitude and 96° 18' and 96° 23' East Longitude at an altitude of about 550 feet above sea-level. It is formed by a depression hemmed in by low ranges of hills on its south, west, and east.² It is somewhat ovoidal in shape, and in the dry season is about 16 miles long, while its maximum breadth, which lies in the southern area near the base, is well over 6 miles. During and after the rains the area of the lake is much more extensive owing to its water spreading over the surrounding country. The northern area of the lake is shallow; the depth at the time of the visit of Dr. B. N. Chopra in 1926 in this region nowhere exceeded 12 feet. The remainder of the lake is fairly deep; in some parts near the south end the depth is at least 40 feet, while according to common belief in places it is as much as 100 feet deep. The lake is fed by several streams, the most important of which, the Nanyinkhan and the Namsanda, open into it on the western shore near the southern and northern corners respectively. A number of small streams also flow into it on the eastern side, while a few of the streams along this side and a few along the southern shore disappear just before reaching the lake; the waters of these streams probably flow into the lake by underground channels. The most important outlet from the lake is along the Indaw River which arises from near the north-eastern corner. The Indaw River runs in a north-easterly direction along a deep but narrow and winding channel

¹ *Indawgyi* literally means "the large Royal Lake" (*in*=lake, *daw*=royal and *gyi*=large), but according to local tradition the name is derived from that of the patron saint *Indawshingyi nat* (*nat*=god-dragon).

² Hertz, W. A., *Burma Gazetteer, Myitkyina District*, p. 13 (Rangoon, 1912).

to Kamaing where it joins with the Namkawng, which river hereafter is known as the Mogaung *Chaung*. Before joining the Namkawng the Indaw receives a hill-stream, the Namtein, from the hills to the east of the Jade Mines. The Mogaung runs in a south-easterly to due south direction to open into the Irrawadi River at Hahkan not very far from Bhamo ; during its course the Mogaung is also fed by several hill-streams.

For the greater part the shores of the lake, except in the rainy season, are more or less definitely marked. During the rainy season and for some time afterwards the lake, as noted above, overflows its banks and at this time a part of the surrounding country also forms a part of it. In the northern area there are no definite shores as the surrounding country consists of marsh land rich with submerged vegetation growing on it. Large masses of aquatic weeds agglutinated together are often found floating in this part of the lake. These masses are not solid enough to support any weight, and differ in this respect from the floating islands of the Inlé Lake in the Southern Shan States. They, however, support a very rich flora and are particularly common near the mouth of the Indaw River.

The bottom of the lake consists of soft blackish clay near the shores, while in the deeper regions there is a large amount of sand mixed with the clay.

The water of the lake is mostly clear, but the large masses of microscopic floating algae, which form the greater part of its planktonic life, give it a distinct greenish tinge. A strong breeze often blows along the surface of the lake in a north to south direction and the waters as a result are often turbid.

The Indawgyi Lake, therefore, may be classed as a eutrophic type¹ of lake. It is a large expanse of water with an extensive shore area but with more or less definite banks ; its water is of a greenish colour, except when it is rendered turbid by the prevailing strong breeze, with a rich planktonic fauna and submerged aquatic vegetation mostly confined to the shallow marginal zone. The fish fauna is fairly rich, but the chief characteristic is the large number of individuals of different species which are found in the lake, and several of which grow to a very large size.

Within recent years the Zoological Survey of India has investigated the fauna of two other lakes, viz., the Inlé Lake in the S. Shan States, Burma, and the Loktak Lake in Manipur, Assam. The Indawgyi Lake lies between these two lakes, and it is, therefore, possible to compare the fish fauna of these three areas. Before doing so, it is necessary to briefly compare the physical characteristics of these three lakes. All the three lakes are situated in open valleys surrounded by ranges of hills running almost due north and south. The altitudes of the lakes are different, the Inlé and the Loktak lakes are situated at an altitude of about 3,000 feet above sea-level, while the altitude of the Indawgyi is only 550 feet. The Inlé and the Loktak lakes are both rather shallow, the water in neither being more than 10-12 feet deep, and they are both remarkable for the great abundance of submerged aquatic vegetation. They are,

¹ See Hentschel, E., *Grundzüge der Hydrobiologie*, p. 188 (Jena, 1923), and Hesse, R., *Tiergeographie auf Oecologischen Grundlage*, p. 355 (Jena, 1924).

further, comparatively smaller areas of water and the shores in neither of them are very definite. The Indawgyi Lake, however, is very large and its depth in several places exceeds 40 feet. Its shores are more definite and the phanerogamic aquatic vegetation, which is confined to the marginal zone, is not so abundant as in the other two lakes, while the greenish water of the Indawgyi Lake is not so clear as that of the Inlé Lake.

We give below a table showing the distribution of the different species of fish in the three lakes.

| | Indawgyi Lake. | Loktak Lake. | Inlé Lake. |
|--|----------------|--------------|------------|
| <i>Amphipnous cuchia</i> (Ham. Buch.). | + | — | + |
| <i>Monopterus albus</i> (Zuiew) | — | + | + |
| <i>Clarias batrachus</i> (Linn.) | + | + | + |
| <i>Silurus cochinchinensis</i> Cuv. & Val. | + | — | — |
| <i>Amblyceps horae</i> , sp. nov. | + | — | — |
| <i>Saccobranchus fossilis</i> (Bloch). | + | — | — |
| <i>Wallago attu</i> (Bl. Schn.) | + | — | — |
| <i>Eutropichthys vacha</i> (Ham. Buch.). | + | — | — |
| <i>Callichrous pabo</i> (Ham. Buch.). | + | — | — |
| <i>Callichrous bimaculatus</i> (Bloch). | — | + | — |
| <i>Aoria aor</i> (Ham. Buch.) | + | — | — |
| <i>Aoria gulio</i> (Ham. Buch.) | + | — | — |
| <i>Aoria cavasius</i> (Ham. Buch.) | + | — | — |
| <i>Aoria bleekeri</i> Day | — | + | — |
| <i>Aoria (Macronoides) dayi</i> (Vincig.). | + | — | — |
| <i>Akysis variegatus</i> subsp. <i>variegatus</i> , nov. | + | — | — |
| <i>Erethistes conta</i> (Ham. Buch.) | + | — | — |
| <i>Lepidocephalichthys berdmorei</i> (Blyth). | + | — | + |
| <i>Lepidocephalichthys irrorata</i> Hora. | — | + | — |
| <i>Garra graveleyi</i> (Annand.) | — | — | + |
| <i>Labeo calbasu</i> (Ham. Buch.) | + | + | — |
| <i>Labeo gonius</i> (Ham. Buch.) | + | — | — |
| <i>Labeo rohita</i> (Ham. Buch.) | + | — | — |
| <i>Labeo pangusia</i> (Ham. Buch.) | — | + | — |
| <i>Cirrhitina latia</i> (Ham. Buch.) | — | — | + |
| <i>Catla catla</i> (Ham. Buch.) | + | — | — |
| <i>Barbus sewelli</i> , sp. nov. | + | — | — |
| <i>Barbus myitkyinae</i> , sp. nov. | + | — | — |
| <i>Barbus sarana caudimarginatus</i> Blyth. | + | + | + |
| <i>Barbus dukai</i> Day | — | — | + |
| <i>Barbus tor</i> (Ham. Buch.) | — | — | + |
| <i>Barbus schanicus</i> Blgr. | — | — | + |
| <i>Barbus stedmanensis</i> Blgr. | — | — | + |
| <i>Barbus nigrovittatus</i> Blgr. | — | — | + |
| <i>Barbus chola</i> (Ham. Buch.) | + | — | — |
| <i>Barbus conchoniui</i> (Ham. Buch.). | — | + | — |
| <i>Barbus ticto</i> (Ham. Buch.) | — | + | — |
| <i>Barbus stoliczkanus</i> Day | — | — | + |
| <i>Barbus phutunio</i> (Ham. Buch.) | + | — | — |
| <i>Barbus sophore</i> (Ham. Buch.) | + | — | — |
| <i>Cyprinus carpio inihia</i> Annand. | — | — | + |
| <i>Saobwa resplendens</i> Annand. | — | — | + |

| | Indawgyi Lake. | Loktak Lake. | Inlé Lake. |
|--|----------------|--------------|------------|
| <i>Rasbora daniconius</i> (Ham. Buch.), | + | — | — |
| <i>Rasbora rasbora</i> (Ham. Buch.) | + | — | — |
| <i>Microrasbora rubescens</i> Annand. | — | — | + |
| <i>Microrasbora erythromicron</i> Annand. | — | — | + |
| <i>Rohitee feae</i> (Vincig.) | + | — | — |
| <i>Rohitee alfrediana</i> (Cuv. & Val.) | + | — | — |
| <i>Rohitee belangeri</i> (Cuv. & Val.) | + | + | — |
| <i>Barilius ornatus</i> Sauvage | — | — | + |
| <i>Barilius auropurpureus</i> Annand. | — | — | + |
| <i>Danio aequipinnatus</i> (McClell.) | — | — | + |
| <i>Laubuca</i> (<i>Laubuca</i>) <i>laubuca</i> (Ham. Buch.). | + | — | — |
| <i>Notopterus notopterus</i> (Pall.) | + | — | + |
| <i>Ambassis ranga</i> (Ham. Buch.) | + | + | — |
| <i>Ambassis baculis</i> (Ham. Buch.) | + | — | — |
| <i>Mastacembelus armatus</i> (Lacép.). | + | — | — |
| <i>Mastacembelus caudicellatus</i> Blgr. | — | — | + |
| <i>Mastacembelus oatesii</i> Blgr. | — | — | + |
| <i>Chaudhuria caudata</i> Annand. | — | — | + |
| <i>Ophicephalus marulius</i> Ham. Buch. | + | — | — |
| <i>Ophicephalus striatus</i> Bloch | + | — | + |
| <i>Ophicephalus gachua</i> Ham. Buch. | + | — | + |
| <i>Ophicephalus harcourtbutleri</i> Annand. | — | + | + |
| <i>Ophicephalus punctatus</i> Bloch. | + | — | — |
| <i>Ophicephalus siamensis</i> Günther. | — | — | + |
| <i>Anabas testudineus</i> (Bloch) | + | — | — |
| <i>Trichogaster fasciatus</i> Bl. Schn. | + | — | — |
| <i>Indostomus paradoxus</i> , gen. et sp. nov. | + | — | — |
| <i>Tetraodon cutculia</i> Ham. Buch. | + | — | — |

It will be seen from this table that the fish fauna of the Indawgyi Lake, consisting of 43 species, is the richest of the three lakes. In the Loktak Lake only 13 species were found, while the Inlé Lake has 28. Two species only, *viz.*, *Clarias batrachus* and *Barbus sarana caudimarginatus*, are found in all the three lakes; a large number of species, which are found in the Indawgyi Lake, are absent in both the Loktak and the Inlé lakes, while a few of the Indawgyi fishes are found in either of the other two lakes. The main characteristic of the fish fauna of the Inlé Lake is the evolution of Cyprinids like *Sawbwa resplendens*, species of the genus *Microrasbora*, the *Mastacembelus*-like genus *Chaudhuria* and several endemic forms which are only found in this lake. The fauna of the Loktak Lake is in no way peculiar, and has no endemic species. In the Indawgyi Lake, the endemic element consists of two species of the genus *Barbus*, *viz.*, *B. sewelli* and *B. myitkyinae*, and *Indostomus paradoxus*, the only known species of the new family Indostomidae of the order Solenichthyes. The fish fauna of these three lakes consists of the usual Indo-Burmese genera of freshwater fish. The fishes of the Indawgyi, except for the marine relict type *Indostomus paradoxus*, which is

found in the lake and probably in its connected waters, do not consist of any very peculiar forms. From the occurrence of only a single marine relict species in an inland water-basin such as the Indawgyi Lake, and which at the present day is only indirectly connected with the nearest marine area, the Bay of Bengal, through the long and circuitous channels of the Irrawadi River system, it would not be right to dogmatize about the age of the Indawgyi Lake, but its importance cannot be ignored, and there can be little doubt that it points to a direct connection of the lake with the Bay of Bengal in a past geological age. Unfortunately we are so far not fully acquainted with the geology of the Myitkyina District, but Pilgrim¹ in his map of the probable distribution of land and water in Eocene times shows this area as forming a part of the Bay of Bengal, and even during Miocene times a part of it was still covered by the sea. Murray Stuart's² geological work was confined to the north-eastern part of the Myitkyina District, but during his traverses he found tertiary rocks to the east of the Indawgyi Lake, and we are informed by Mr. E. L. G. Clegg of the Geological Survey of India that recent work in the Jade Mines area has confirmed these findings. It may, therefore, be assumed that in the early Tertiaries, at any rate, the Indawgyi area formed a part of the extension of the Bay of Bengal, and that *Indostomus paradoxus* probably represents a descendant of some marine type which was left in this region after it was cut off from the sea, and became transformed into a freshwater lake.

In the systematic account we have often given detailed descriptions of the different species of fish found in the Myitkyina District. This was found necessary as our specimens did not agree in all details with the published descriptions of the species. In most cases we had to examine the large collections in the Indian Museum from different parts of India, and notes on some of the specimens from other areas are also included. In addition to the figures of the new forms we have also thought it desirable to publish figures of some of the old species of which no good figures were available.

SYSTEMATIC DESCRIPTION.

Family SYMBRANCHIDAE.

Amphipnous cuchia (Ham. Buch.).

1822. *Unibranchapertura Cuchia*, Hamilton Buchanan, *Fish. Ganges*, pp. 16, 363, pl. xvi, fig. 4.
 1878. *Amphipnous cuchia*, Day, *Fish. India*, p. 656, pl. clxviii, fig. 1.
 1889. *Amphipnous cuchia*, Day, *Faun. Brit. Ind., Fish.* 1, p. 69, fig. 27.
 1889. *Amphipnous cuchia*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 356.
 1918. *Amphipnous cuchia*, Annandale, *Rec. Ind. Mus.*, XIV, p. 43.

This species is represented by two specimens which, according to the field notes of Dr. B. N. Chopra, were "dug out with earthworms from near the south end of the Indawgyi Lake" in the Myitkyina District.

¹ Pilgrim, G. E., *Journ. Asiat. Soc. Bengal* (n. s.) XIX, pl. i (1920).

² Murray Stuart, *Rec. Geol. Surv. Ind.*, LIV, pp. 398-411, pl. xx (1923). We have to thank Mr. E. L. G. Clegg of the Geological Survey of India for reference to this paper and other information about the geology of the district.

The living specimens according to Dr. Chopra were "reddish in colour with darker longitudinal bands."

The species is recognised as a fish by the Burmese but is apparently not commonly eaten.

***Monopterus albus* (Zuiew).**

1793. *Mureana alba*, Zuiew, *Nov. Act. Soc. Petropol.*, VII, p. 299.
 1800. *Monopterus javanensis*, Lacépède, *Hist. Nat. Poisson.*, II, p. 139.
 1870. *Monopterus javanensis*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 14.
 1878. *Monopterus javanensis*, Day, *Fish. India*, p. 656, pl. clxix, fig. 1.
 1889. *Monopterus javanensis*, Day, *Faun. Brit. Ind., Fish.* I, p. 70, fig. 28.
 1901. *Monopterus albus*, Jordan & Snyder, *Proc. U. S. Nat. Mus.*, XXIII, p. 838.
 1916. *Monopterus albus*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, III, pp. 413, 414, figs. 210, 211.
 1918. *Monopterus albus*, Annandale, *Rec. Ind. Mus.*, XIV, p. 42.
 1921. *Monopterus albus*, Hora, *Rec. Ind. Mus.*, XXII, p. 177.

This species is represented by a single specimen which was obtained from Kamaing in the Myitkyina District. It is 115 mm. long.

It is not a common species in the area round Indawgyi Lake and the Burmese do not apparently distinguish it from *Amphipmous cuchia*.

Family SILURIDAE.

***Clarias batrachus* (Linn.).**

1758. *Silurus batrachus*, Linnaeus, *Syst. Naturae* (ed. 10th), p. 305.
 1822. *Macropteronotus Magur*, Hamilton Buchanan, *Fish. Ganges*, pp. 146, 374, pl. xxvi, fig. 45.
 1862. *Clarias batrachus*, Bleeker, *Atl. Ichth.*, II, p. 103.
 1864. *Clarias magur*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 17.
 1877. *Clarias magur*, Day, *Fish. India*, p. 485, pl. cxii, figs. 5, 5a.
 1889. *Clarias magur*, Day, *Faun. Brit. Ind., Fish.* I, p. 115, figs. 48, 49.
 1889. *Clarias magur*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 191.
 1913. *Clarias batrachus*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, II, p. 190, fig. 74.
 1918. *Clarias batrachus*, Annandale, *Rec. Ind. Mus.*, XIV, p. 43.
 1921. *Clarias batrachus*, Hora, *Rec. Ind. Mus.*, XXII, p. 178.
 1923. *Clarias batrachus*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 165.

The ground colour of the specimens is somewhat dusky rather than black, while there are numerous white spots scattered all over the body. Three slightly arched vertical bands of a lighter colour are present on the caudal fin. The pectoral spine is finely serrated along both its outer and inner surfaces.

C. batrachus is fairly common in and about the marginal zones of the Indawgyi Lake. The largest specimen in the collection is 135 mm. long.

***Silurus cochinchinensis* Cuv. & Val.**

1839. *Silurus Cochinchinensis*, Cuvier & Valenciennes, *Hist. Nat. Poisson.*, XIV, p. 352.
 1860. *Silurichthys Berdmorei*, Blyth, *Journ. Asiat. Soc. Bengal*, XXIX, p. 156.
 1877. *Silurus Cochinchinensis*, Day, *Fish. India*, p. 481, pl. cxiii, fig. 2.
 1889. *Silurus cochinchinensis*, Day, *Faun. Brit. Ind., Fish.* I, p. 120.

The lower jaw is slightly shorter than the upper and there is a row of large open pores arranged in a line parallel to the margin of the lower

jaw. These pores, as was confirmed by an examination of Day's specimens of the species from Akyab, are present in this species generally, but Day does not mention them in his description.

The pectoral spine, though slender, is fairly strong and about half as long as the pectoral rays. The anal fin is inserted just behind the ventral. The maxillary barbels are dusky-grey while the mandibulars are pale white.

S. cochinchinensis is fairly common in the lake and in some of the streams opening into it. In the collection there are three specimens from the north end of the lake near Nyaungbin, and two from Sattan *chaung* running near and inside the Paudawmu cave about 8 miles from Kamaing, in the Myitkyina District. The specimens vary from 85-120 mm. in length.

Amblyceps Blyth.

Blyth¹ established the genus *Amblyceps* in 1858, and defined it as "affined to *Olyra*, McClelland, but the head much broader and flatter, with minute eyes, placed near the hind aperture of the nostrils; two pairs of cirri above and below, the inner above situate between the fore and hind apertures of the nostrils; pectoral and dorsal spines short and concealed, but comparatively robust; the second or adipose dorsal short and low; and the ventrals and anal also short; tail large and moderately furcate; a band of card-like teeth above and below, but no palatal band discernible in the specimens; body subcylindrical, compressed, becoming more so to the tail." Günther² in reviewing Blyth's definition defined the genus as follows:

"Adipose fin short and low; a short dorsal fin with a concealed pungent spine and with six soft rays; anal fin short. Barbels eight. Teeth villiform; palate edentulous. Head covered with soft skin above; eyes very small. Lateral line none? Caudal forked; no thoracic adhesive apparatus; ventrals with six rays, inserted behind the end of the dorsal fin."

Day³ followed Blyth and Günther, and did not make any remarks about the presence or absence of the lateral line in the genus. In his *Report on the Freshwater Fish and Fisheries of India and Burma* (1873) he, however, stated that the lateral line is absent.

Chaudhuri,⁴ in view of the description of *A. marginatus* Günther⁵ and of his new species, *A. murray-stuarti* Chaudhuri, pointed out the necessity of modifying the definition of the genus *Amblyceps*. In both these species the caudal fin is "square cut" and not furcate. In *A. murray-stuarti* further "there appear to be about thirteen loose folds of skin over the posterior part of the chest continued to the anterior portion of the abdominal region which are likely to possess some adhesive function." A new species of the genus from the Indawgyi Lake, which we associate with the name of Dr. S. L. Hora, shows several new characters.

¹ Blyth, E., *Proc. Asiat. Soc. Bengal*, XXVII, p. 281 (1858).

² Günther, A., *Cat. Fish. Brit. Mus.*, V, p. 190.

³ Day, F., *Fish. India*, p. 490.

⁴ Chaudhuri, B. L., *Rec. Ind. Mus.*, XVI, p. 273 (1919).

⁵ Günther, A., In Pratt's *To the Snows of Tibet through China*, p. 245, pl. ii, fig. 4 (1892).

It is, therefore, necessary to give an emended definition of the genus *Amblyceps*. It is as follows :—

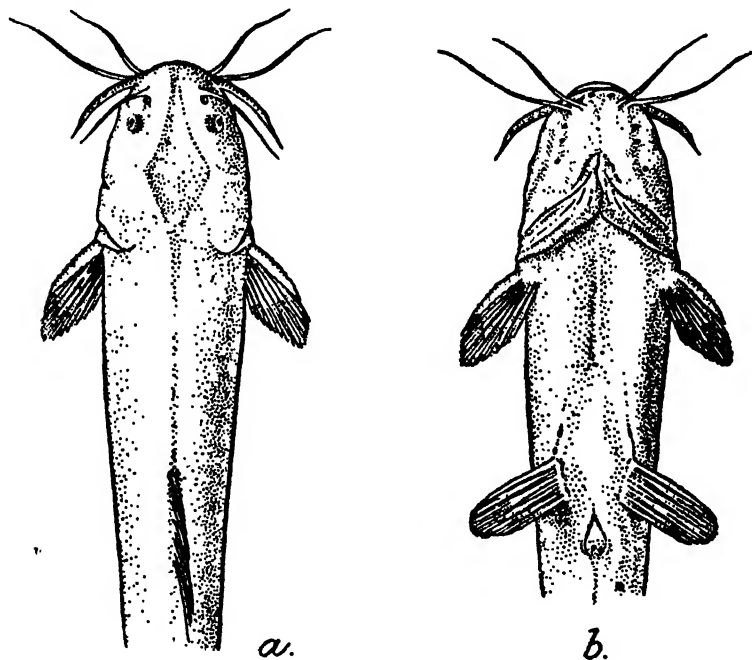
A thoracic adhesive area may be well developed, rudimentary or absent. The gape of the mouth may be moderate or extensive. The dorsal fin consists of one spine and six or seven rays. The ventral fin is situated immediately below or far behind the dorsal fin. The caudal may be forked, subtruncate or truncate. The lateral line may be present or absent.

***Amblyceps horae*, sp. nov.**

(Plate VII, fig. 1.)

D. 1/7, A. 10/11, P. 1/7, V. 6, C. 38-40.

The length of the head is contained about 6 times and the depth of the body about 8·7 times in the total length of the body without the caudal. The diameter of the eye is contained 9·2 times in the length of



TEXT-FIG. 1.—*Amblyceps horae*, sp. nov.

- (a) Dorsal view of anterior portion of body of type-specimen, $\times 2$.
 (b) Ventral view of anterior portion of body of the same, $\times 2$.

the head, which is 1·5 times wider than deep. The length of the snout is equal to the interorbital width. The jaws are nearly equal, and the lips more or less fleshy. There is a row of fairly large open pores along the margin of the lower jaw and a few scattered ones laterally along the cheeks.

The dorsal fin is situated above the ventral. The pectoral, which originates immediately behind the gill opening, is as long as the head

behind the middle of the eye. The pectoral spine is slightly longer and stronger than that of the dorsal; it is flattened dorso-ventrally and serrated along both its anterior and posterior edges. The ventral, which is situated midway between the gill openings and the commencement of the anal, is longer than the pectoral. The anal is long and moderately high. The caudal is longer than the head, and deeply emarginate. The adipose dorsal is inserted above the middle of the anal and is continuous with the caudal fin. The vent is situated slightly posterior to the ventral and is provided with a distinct papilla. All the fin rays are concealed in the thick skin.

There are 8 barbels, a pair each of nasals and maxillaries and two pairs of mandibulars. The nasal barbels are slender and when straightened out reach the posterior end of the preoperculum. The maxillary barbels are more or less damaged. The outer mandibular pair are longer than the inner. The lateral line is complete and distinct.

The colour of the specimen preserved in spirit is dark brownish above and paler below, with minute blackish spots thickly scattered all over the surface. The fins are dirty white, except for the caudal which is more or less blackish.

We have a single specimen of *A. horae* which was collected from the shallow parts of the Indawgyi Lake along its western shore near Loimon village, in the Myitkyina District.

Type-specimen.—No. F 10854/1 in the collection of the Zoological Survey of India (*Ind. Mus.*), Calcutta.

Remarks.—*A. horae* is a very characteristic species and is easily distinguished from the other species of the genus by the dorsal fin being situated far back, the serrated pectoral spine, and the presence of a distinct and complete lateral line.

Measurements in millimetres.

| | | | | |
|---------------------------------|----|----|----|------|
| Total length without caudal | .. | .. | .. | 70.0 |
| Length of head | .. | .. | .. | 11.5 |
| Height of body | .. | .. | .. | 8.0 |
| Length of snout | .. | .. | .. | 4.0 |
| Diameter of eye | .. | .. | .. | 1.25 |
| Interorbital width | .. | .. | .. | 4.0 |
| Length of caudal peduncle | .. | .. | .. | 11.0 |
| Least height of caudal peduncle | .. | .. | .. | 8.0 |
| Length of pectoral fin | .. | .. | .. | 7.0 |
| Length of ventral fin | .. | .. | .. | 8.0 |

Saccobranchus fossilis (Bloch).

1794. *Silurus fossilis*, Bloch, *Nat. Ausl. Fische*, VIII, p. 46, pl. ccclii, fig. 2.
 1822. *Silurus Singio*, Hamilton Buchanan, *Fish. Ganges*, pp. 147, 374, pl. xxxvii, fig. 46.
 1840. *Saccobranchus singio*, Cuvier & Valenciennes, *Hist. Nat. Poisson.*, XV, p. 400, pl. cccclxviii.
 1864. *Saccobranchus fossilis*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 31.
 1877. *Saccobranchus fossilis*, Day, *Fish. India*, p. 486, pl. cxiv, fig. 1.
 1889. *Saccobranchus fossilis*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 125, fig. 53.
 1913. *Saccobranchus fossilis*, Chaudhuri, *Rec. Ind. Mus.*, VII, p. 255.
 1916. *Saccobranchus fossilis*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 262.

The fish is blackish above and much lighter below. As Day¹ has already remarked "in the Burmese specimens, as a rule, there are two

¹ Day, F., *Proc. Zool. Soc. London*, p. 612 (1869).

longitudinal yellowish-white bands", which, however, are seldom present in the Indian specimens.

S. fossilis does not appear to be very common in the lake. Only a single specimen was collected from its south end. It is 74 mm. long. There is also in the collection under report another specimen, 155 mm. long, from the Namkawng stream at Kamaing, in the Myitkyina District.

Wallago attu (Bl. Schn.).

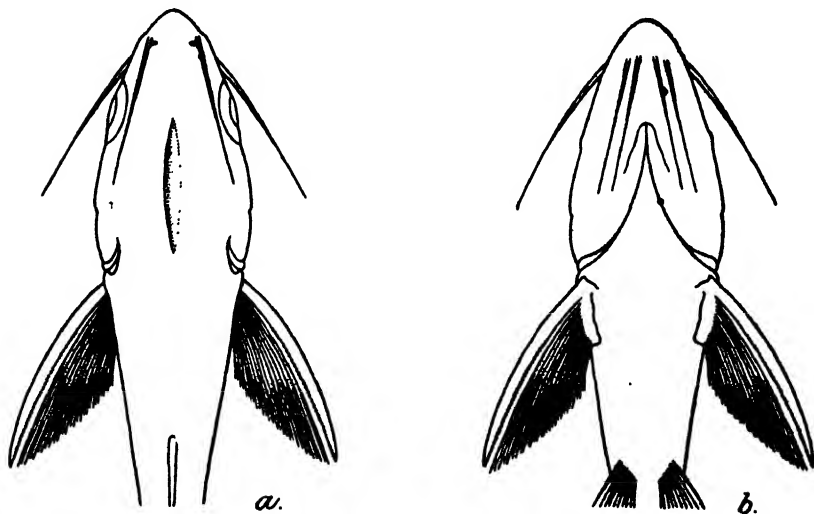
1801. *Silurus attu*, Bloch & Schneider, *Syst. Ichth.*, p. 378.
 1852. *Wallago Muteri*, Bleeker, *Nat. Tijdschr. Ned. Ind.*, III, p. 585.
 1862. *Wallago attu*, Bleeker, *Atl. Ichth.*, II, p. 79.
 1864. *Wallago attu*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 36.
 1877. *Wallago attu*, Day, *Fish. India*, p. 479, pl. cxi, fig. 4.
 1889. *Wallago attu*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 126, fig. 54.
 1889. *Wallago attu*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 199.
 1913. *Wallago attu*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, II, p. 201.
 1923. *Wallago attu*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 165.

The eyes in the specimens before us are situated at a distance about 3 times the diameter of the eye from the tip of the snout and not "2 diameters" as described by Day.

W. attu is fairly common in the lake and grows to a large size; one specimen from the shallower parts of the lake on the western side is 45 cm. long.

Eutropiichthys vacha (Ham. Buch.).

1822. *Pimelodus Vacha*, Hamilton Buchanan, *Fish. Gan ges*, pp. 196, 378, pl. xix, fig. 64.
 1863. *Eutropiichthys vacha*, Bleeker, *Ned. Tijd. Dierk.*, p. 107.
 1864. *Eutropiichthys vacha*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 38.
 1877. *Eutropiichthys vacha*, Day, *Fish. India*, p. 490, pl. cxiv, fig. 6.
 1889. *Eutropiichthys vacha*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 128, fig. 55.
 1889. *Eutropiichthys vacha*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 199.



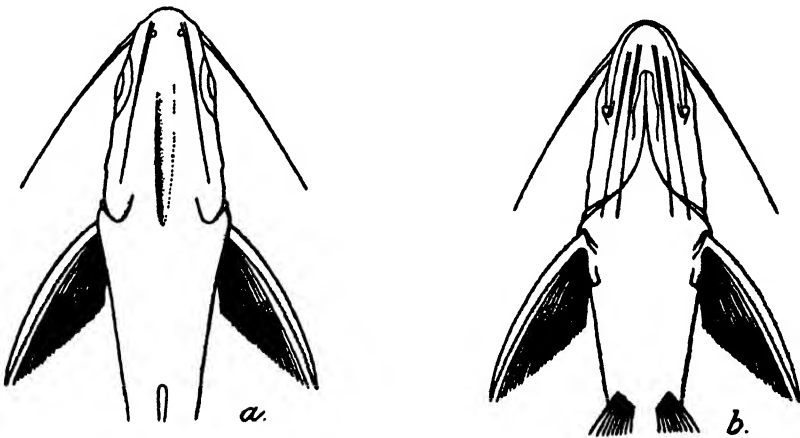
TEXT-FIG. 2.—*Eutropiichthys vacha* (Ham. Buch.) with pointed snout from Myitkyina District.

- (a) Dorsal view of anterior portion of body.
 (b) Ventral view of anterior portion of body.

The specimens which are assigned to *E. vacha* differ considerably from Day's description of the species. According to Day the diameter of the eye is " $3\frac{1}{2}$ to $3\frac{1}{4}$ in the length of the head, 1 diameter from the end of the snout and 1 to $1\frac{1}{4}$ apart," but in the specimens before us the corresponding proportions are $4\frac{1}{2}$ to 5, $1\frac{1}{2}$ and 2 to $2\frac{1}{2}$. The angle of the mouth is situated just below the posterior margin of the orbit and not as noted by Day, "under the middle or hind third of the eyes." The length of the barbels is somewhat variable. In specimens of moderate size, viz., about 200–300 mm. in length, the nasal barbels generally reach the posterior margin of the head, but in older specimens they are much shorter and do not extend beyond the posterior margin of the orbit. The maxillary barbels reach up to the middle or the end of the preoperculum, while the mandibular pairs are considerably shorter.

According to Day the pectoral spine is as long as that of the dorsal, but in the Indawgyi specimens, as also in several others from Day's collection in the Indian Museum, the pectoral spine is much stronger and considerably longer than the dorsal. Day described the ventral fins as "situated under the posterior dorsal rays," but in all the specimens examined by us this fin is inserted immediately below the commencement of the dorsal.

Day (*op. cit.*) distinguished a Burmese variety which he had originally designated as *E. burmanicus*. We have not seen this variety, but the specimens before us differ from Day's description of the Burmese form in the barbels being much shorter and the pectoral spine not reaching the anal.



TEXT-FIG. 3.—*Eutropiichthys vacha* (Ham. Buch.) with blunt snout from the Punjab.

(a) Dorsal view of anterior portion of body.

(b) Ventral view of anterior portion of body.

It may also be noted that in addition to Day's *E. burmanicus* there are two more or less distinct forms of *E. vacha* and which can be easily distinguished by their different facies. In the first form (fig. 2) the snout is very sharp and pointed and the barbels are short, while in the second form (fig. 3) the snout is blunt and more or less rounded and the barbels, though shorter than those of *E. burmanicus*, are considerably longer. The specimens from the lake have a pointed snout.

In the collections of the Indian Museum *E. vacha* is not represented from different parts of India and we are, therefore, unable at present to define the distribution, etc., of the two forms mentioned above. The difference in the shape of the snout does not appear to be anything more than a local variation, but it is interesting to note that the form with a pointed snout, such as the one found in the Indawgyi Lake and the rivers in Upper Burma, is also represented in the Indian Museum collection by specimens from the River Beas in the Punjab.

E. vacha is fairly common in the lake and the Indaw and Nam Ting rivers. It is said to inhabit the deeper parts and to grow to a weight of about 30 lbs.

Four specimens of this species were collected ; one from the western part of the lake and three from the river waters at Chaungwa, in the Myitkyina District. The specimen from the lake is 325 mm. long.

***Callichrous pabda* (Ham. Buch.).**

1822. *Silurus pabda*, Hamilton Buchanan, *Fish. Ganges*, pp. 150, 374, pl. xxv, fig. 47.
 1839. *Callichrous vittatus*, Swainson, *Nat. Hist. Fish.* II, p. 306.
 1864. *Callichrous pabda*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 47.
 1877. *Callichrous pabda*, Day, *Fish. India*, p. 479, pl. cxl, figs. 2, 3.
 1889. *Callichrous pabda*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 133.
 1914. *Callichrous pabda*, Regan, *Ann. Mag. Nat. Hist.* (8) XIII, p. 261.
 1921. *Callichrous pabda*, Hora, *Rec. Ind. Mus.*, XXII, p. 743.

The lower jaw is very prominent and more or less elevated at the symphysis. The ventral fin is inserted below the dorsal and just reaches the anal which is separated from the caudal by a notch. The general colour of the body in spirit is silvery with a golden sheen. There is a darker shoulder spot and many minute dark-brown spots and irregular blotches distributed all over the body. The maxillary barbels are dusky. There is a single row of large open pores widely separated from one another and lying parallel to the margin of the lower jaw. The pectoral spine is smooth and very sharp at the tip.

C. pabda has so far not been recorded from Burma. In the collection before us it is represented by three specimens, two from the shallower parts of the western area of the lake and one from Namkawng stream at Kamaing, in the Myitkyina District. These specimens range from 75-115 mm. in length.

***Callichrous pabo* (Ham. Buch.).**

1822. *Silurus pabo*, Hamilton Buchanan, *Fish. Ganges*, pp. 153, 375, pl. xxii, fig. 48.
 1864. *Callichrous pabo*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 48.
 1877. *Callichrous pabo*, Day, *Fish. India*, p. 477, pl. cx, fig. 6.
 1889. *Callichrous pabo*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 132.

The diameter of the eye is $5\frac{1}{2}$ in the length of the head and about $2\frac{1}{2}$ diameter from the tip of the snout ; the interorbital distance is $3\frac{1}{2}$ diameters of the eye. The greatest width of the head equals its length from the tip of the snout to the angle of the mouth. The lower jaw is prominent and has a distinct central knob-like projection on the symphysis. The width of the mouth is longer than half the length of the head. The maxillary barbels extend a little beyond the hind edge of the

orbit. The mandibular barbels are slender and about twice the diameter of the eye.

The pectoral fins are slightly shorter than the head excluding the snout.

Day found in Burma a variety of this fish "clouded all over with fine dark spots." This is the case with the specimens under report. Further, he observed that the pectoral spine is entire in Burmese specimens, but this does not seem to be generally the case, as distinct serrations are present on the pectoral spines of the specimens under report, as also in some specimens from Pegu in the Indian Museum from Day's collection.

No specimens of *C. pabo* were obtained from the lake. In the collection before us the species is, however, represented by two specimens from Namkawng *chaung* at Kamaing, in the Myitkyina District. They are 210 mm. long.

***Pseudeutropius taakree* (Sykes).**

1841. *Hypophthalmus Taakree*, Sykes, *Trans. Zool. Soc. London*, II, p. 369, pl. lxiv, fig. 4.
 1864. *Pseudeutropius longimanus*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 60.
 1867. *Eutropius taakree*, Day, *Proc. Zool. Soc. London*, p. 564.
 1869. *Pseudeutropius taakree*, Day, *Proc. Zool. Soc. London*, p. 617.
 1877. *Pseudeutropius taakree*, Day, *Fish. India*, p. 471, pl. cix, fig. 4.
 1889. *Pseudeutropius taakree*, Day, *Faun. Brit. Ind., Fish.* I, p. 138.
 1889. *Pseudeutropius taakree*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 205.

The specimens of this species from different localities appear to vary considerably. The samples before us from Kamaing differ from Day's description mainly in their head being broader, the maxillary barbels shorter, the mandibulars longer and the pectoral spines shorter; the dorsal as well as the pectoral spines besides being denticulated posteriorly, are finely serrated anteriorly. Day "obtained in Burma, as high as Mandalay," specimens apparently belonging to this species but with a shorter pectoral spine. It is quite possible that the Burmese specimens of *P. taakree* are distinct from the Indian.

P. taakree was not found in the Indawgyi Lake. It is common in the rivers and *chaungs* in the Myitkyina District.

Three specimens were collected by Dr. Chopra at Kamaing. The largest one is 330 mm. long.

***Aoria*¹ *aor* (Ham. Buch.).**

1822. *Pimelodus aor*, Hamilton Buchanan, *Fish. Ganges*, np. 205, 379, pl. xx, fig. 68.
 1864. *Macrones aor*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 78.
 1877. *Macrones aor*, Day, *Fish. India*, p. 444.
 1889. *Macrones aor*, Day, *Faun. Brit. Ind., Fish.* I, p. 149.
 1889. *Macrones aor*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 217.

It is of interest to note that the dorsal spine is serrated only in about $\frac{1}{2}$ — $\frac{3}{4}$ of the upper posterior margin.

A. aor occurs in the Indawgyi Lake in great abundance and grows to a very large size. This fish is caught in large quantities throughout the year and is one of the commonest edible fish in Upper Burma.

¹ Jordan, D.S.—*Genera of Fishes*, IV, p. 567 (1919).

In the collection *A. aor* is represented by five specimens from different parts of the lake ; the largest of these is 40 cm. long.

***Aoria gulio* (Ham. Buch.).**

1822. *Pimelodus gulio*, Hamilton Buchanan, *Fish. Ganges*, pp. 201, 379, pl. xxii, fig. 66.
 1864. *Macrones gulio*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 79.
 1877. *Macrones gulio*, Day, *Fish. India*, p. 445, pl. xcix, fig. 2.
 1889. *Macrones gulio*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 151, fig. 64.
 1889. *Macrones gulio*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 229.
 1913. *Macrones gulio*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, II, p. 344.
 1923. *Macrones gulio*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 171.
 1927. *Aoria gulio*, Mukerji, *Rec. Ind. Mus.*, XXIX, pp. 249-251.

The nasal barbels extend to about the middle of the orbit, the maxillaries to the middle of the ventrals, the mandibulars as far as the base of the pectorals and the mentals are about $\frac{1}{2}$ the length of the mandibulars. The pectoral spine is almost as long as the dorsal spine, but much stronger and is ridged longitudinally ; the dorsal spine is granulated.

A. gulio is represented in the collection by a single specimen collected from the western part of the lake which appears to have migrated from the rivers through some stream opening into the lake. The specimen is 300 mm. long.

***Aoria cavasius* (Ham. Buch.).**

1822. *Pimelodus cavasius*, Hamilton Buchanan, *Fish. Ganges*, pp. 203, 379, pl. xi, fig. 67.
 1864. *Macrones cavasius*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 76.
 1877. *Macrones cavasius*, Day, *Fish. India*, p. 447, pl. c, fig. 1.
 1889. *Macrones cavasius*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 155.
 1889. *Macrones cavasius*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 218.
 1916. *Macrones cavasius*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 264.

The nasal barbels are shorter than the head ; the maxillary barbels in the majority of specimens do not extend beyond the end of the anal fin ; the outer mandibular barbels extend almost to the tip of the pectoral spine. The maxillary and the nasal barbels are blackish. The dorsal spine is shorter than the head excluding the snout.

A. cavasius is common in the northern area of the Indawgyi Lake and in the muddy streams at Kamaing in the Myitkyina District. Two specimens from the lake and 4 from the muddy streams were obtained. They vary in length from 60-72 mm.

***Aoria leucophasis* (Blyth).**

1860. *Bagrus leucophasis*, Blyth, *Proc. Asiat. Soc. Bengal*, XXIX, p. 148.
 1864. *Macrones leucophasis*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 78.
 1877. *Macrones leucophasis*, Day, *Fish. India*, p. 449, pl. c, fig. 2.
 1889. *Macrones leucophasis*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 158.
 1889. *Macrones leucophasis*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 220.

The dorsal and the pectoral spines bear longitudinal striations. The axillary process which is more or less triangular is strong and granulated.

In some specimens the maxillary barbels extend to about the base of the caudal fin. Only $\frac{3}{4}$ of the distal part of the pectoral spine is denticulated. The adipose dorsal fin commences behind the rayed

dorsal at a distance equalling almost $\frac{3}{4}$ the length of the base of the latter and not "just behind" it as noted by Day. The length of the base of the second dorsal in the specimens before us is at the most $1\frac{1}{2}$ times the length of the first dorsal and not "twice to two and a half times."

A. leucophasis is very common in the Indaw and the Nam Ting rivers, but is rarely found in the lake.

Nineteen specimens were collected at Chaungwa, a large fishing village at the junction of the Indaw and the Nam Ting rivers, in the Myitkyina District. The largest specimen is 250 mm. long.

Aoria pulcher (Chaudhuri).

1911. *Macrones pulcher*, Chaudhuri, *Rec. Ind. Mus.*, VI, pp. 20-22, pl. i, fig. 4.

We have examined the type-series of *A. pulcher* preserved in the Indian Museum collection and find that the specimens under report from the Myitkyina District are similar to the types of the species from the Bhamo District.

A. pulcher is not known to occur in the lake. Eight specimens were procured from small muddy streams along the Kamaing Jade Mines Road, in the Myitkyina District.

Chaudhuri's largest specimen is 67 mm. long, while the largest one in the collection before us is 75 mm. in length.

Aoria (Macronoides) dayi (Vincig.).

1889. *Macrones Dayi*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, pp. 230-235, pl. vii, fig. 3.

1921. *Macrones (Macronoides) dayi*, Hora, *Rec. Ind. Mus.*, XXII, pp. 179, 737.

Hora has separated this species along with *Aoria affinis* (Blyth) and *Aoria merianiensis* (Chaudhuri) into a distinct subgenus *Macronoides*. "The fishes of this subgenus are readily distinguished by their short barbels which do not exceed the length of the head, by possession of pores on the undersurface of the head and by the fact that the mandibular pairs of barbels are placed in an almost horizontal line."

We have compared our specimens with one out of Vinciguerra's type-series recently presented by him to the Zoological Survey of India at the request of Dr. Hora. They agree in every detail with the typical form.

A. (Macronoides) dayi occurs in the lake, as also in the rocky streams at Kamaing, in the Myitkyina District.

In the collection there are two specimens from the rocky streams at Kamaing and a single one from the north end of the Indawgyi Lake. They vary from 39-47 mm. in length.

Akysis variegatus subsp. *variegatus*, nov.

(Plate VIII^f, figs. 1, 2.)

This new subspecies, for which we propose the name *variegatus*, is closely allied to both *Akysis variegatus* Bleeker¹ and *Akysis pictus* Günther²

¹ Bleeker, P.—*Ichth. Arch. Ind. Prodr. l. Siluri.*, p. 235 (1858). For a recent description of the species see Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, II, p. 372, fig. 150.

² Günther, A.—*Ann. Mag. Nat. Hist.* (5) XI, p. 138 (1833).

reported from Java and Tenasserim respectively, but differs from either species chiefly in the composition of the pectoral and the anal fins. In the pectoral fins of *A. variegatus* and *A. pictus*, there are "5-6" and "7" branched rays respectively, while in the specimens before us there are 8. Likewise, the anal fins of the two known species are composed of "8-9" and "9" rays respectively, while in the specimens under report there are 11. From Günther's species the new form further differs in its longer nasal, shorter maxillary and longer outer mandibular barbels; its dorsal fin is also more anteriorly situated. In colouration and general facies it bears a closer resemblance to *A. variegatus* than to *A. pictus*.

In the absence of any specimens of the two species referred to above for comparison, it is difficult to be definite about the specific position of this apparently new form, but we consider it to be a variety of *A. variegatus*.

This new variety is represented in the collection by three specimens, one from the shallower parts of the Indawgyi Lake along the southwestern shore and 2 from small rocky streams roundabout Kamaing in the Myitkyina District.

Type-specimen.—No. F 10873/1 in the collection of the Zoological Survey of India (*Ind. Mus.*), Calcutta.

Measurements in millimetres.

| | | | | |
|---------------------------------|----|----|------|------|
| Total length without caudal | .. | .. | 40.0 | 23.0 |
| Length of head | .. | .. | 9.0 | 6.0 |
| Depth of head | .. | .. | 6.0 | 3.0 |
| Width of head | .. | .. | 11.0 | 6.5 |
| Height of body | .. | .. | 9.0 | 4.0 |
| Length of snout | .. | .. | 3.5 | 3.0 |
| Diameter of eye | .. | .. | 7.5 | .5 |
| Interorbital width | .. | .. | 3.5 | 2.0 |
| Length of caudal peduncle | .. | .. | 8.0 | 4.5 |
| Least height of caudal peduncle | .. | .. | 4.0 | 2.0 |

***Bagarius bagarius* (Ham. Buch.).**

1822. *Pimelodus bagarius*, Hamilton Buchanan, *Fish. Ganges*, pp. 186, 378, pl. vii, fig. 62.
 1841. *Bagrus Yarrelli*, Sykes, *Trans. Zool. Soc. London*, II, p. 370, pl. lxxv, fig. 1.
 1853. *Bagarius Buchanani*, Bleeker, *Atl. Ichth.* II, p. 61, pl. 81, fig. 33.
 1864. *Bagarius yarrellii*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 183.
 1877. *Bagarius Yarrelli*, Day, *Fish. India*, p. 495, pl. cxv, fig. 3.
 1889. *Bagarius yarrellii*, Day, *Faun. Brit. Ind., Fish.* I, p. 194, fig. 71.
 1889. *Bagarius Yarrellii*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 243.
 1912. *Bagarius bagarius*, Weber & Beaufort, in Maass "Durch Zentral-Sumatra," Bd. II, Fische, p. 16.
 1913. *Bagarius bagarius*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, II, p. 270, fig. 105.

The maxillary barbels are shorter than the head and extend as far back as the first quarter of the pectoral fin. The dorsal spine is rugose anteriorly and almost smooth posteriorly.

No specimens of *B. bagarius* were found in the Indawgyi Lake, and the only specimen in the collection was taken at Kamaing, in the Myitkyina District. It is 205 mm. long.

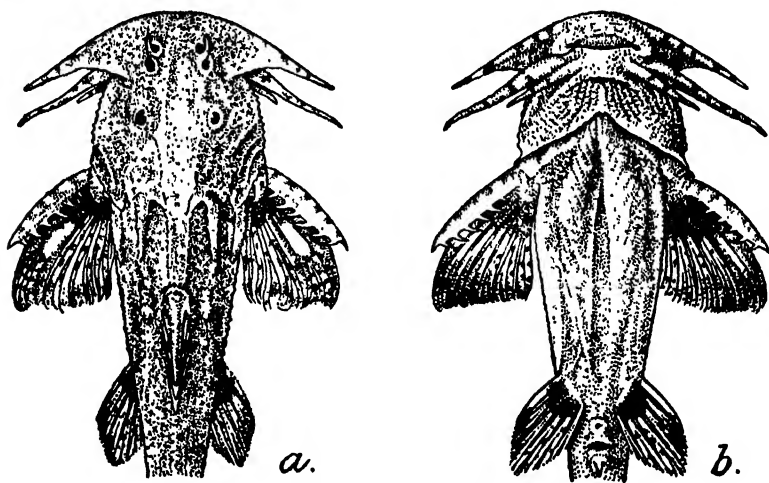
***Glyptothorax tuberculatus*, sp. nov.**

(Plate VII, fig. 2.)

D. 1/6, A. 2/8, P. 1/7, V. 1/5, C. 20.

The head is slightly longer than broad and much broader than deep. Its length is contained about 3.3 times and the depth of the body nearly 4.3 times in the total length of the body excluding the caudal. The snout is broadly rounded anteriorly and is longer than the postorbital part of the head. The eyes, which are situated in the posterior half of the head, are small. The interorbital width is equal to the distance between the anterior margin of the orbit and the base of the nasal barbels.

There are four pairs of barbels. The nasals are about $1\frac{1}{2}$ times as long as the diameter of the eye. The maxillary barbels, which are very much flattened at their bases, are stout and do not extend very much beyond the posterior end of the eye. The outer pair of mandibular barbels are nearly as long as the maxillary and extend to the free margin of the opercular flap, while the inner pair are about $\frac{2}{3}$ of the length of the outer.

TEXT-FIG. 4.—*Glyptothorax tuberculatus*, sp. nov.

- (a) Dorsal view of anterior portion of body of type-specimen, $\times 2\frac{1}{2}$.
 (b) Ventral view of anterior portion of body of the same, $\times 2\frac{1}{2}$.

The upper jaw is longer than the lower. The gape of the mouth is moderate and the lips, especially the upper, are fleshy. The adhesive apparatus on the thorax is well developed. It is considerably longer than broad and has an elongated slight depression in its middle (fig. 4b). The anus is situated midway between the bases of the ventrals and the anal.

The dorsal fin is inserted above the posterior third of the pectorals; its spine is very strong and is almost equal to the length of the head excluding the snout. The longest dorsal ray is shorter than the depth of the body and is equal to the length of the head behind the posterior nostrils. The pectorals are as long as the dorsal; the spine is flat, strong and internally denticulated, and does not bear any adhesive apparatus

on its ventral surface. The ventrals, which originate immediately below the end of the base of the dorsal, are shorter than the pectorals. The anal, which commences below the middle of the adipose dorsal, is as long as the rayed dorsal. The adipose dorsal starts as a low ridge just behind the first dorsal and extends to about the termination of the anal, where it is a little better developed. The caudal is slightly shorter than the head. It is deeply furcate, both its lobes being almost of the same size.

The median longitudinal groove on the head is shallow but fairly prominent and extends to the base of the occipital process which latter is about three times as long as wide at the base. The humero-cubital process is roughened and has an elongated osseous projection posteriorly. In between the occipital and the humero-cubital processes, there is a scapular projection above the lateral line. The skin is rough and the whole body is thickly covered with minute tubercles.

The colour of the type-specimen in spirit is dark-brown variegated with irregular blackish patches. The fins are blackish with broad whitish vertical bands. The chest and the lower part of the head are dirty yellow. The maxillary and the mandibular barbels are annulated with black.

G. tuberculatus is represented in the collection by a single well preserved specimen. It is a mature female with eggs. The specimen was collected from Sankha, a large hill-stream, midway between Kamaing and Mogaung, in the Myitkyina District.

Type-specimen.—No. F.10876/1 in the collection of the Zoological Survey of India (*Ind. Mus.*), Calcutta.

Remarks.—The presence of humero-cubital and scapular processes is not a common feature in the genus *Glyptothorax*. In this respect *G. tuberculatus* resembles species of the genera *Erethistes* and *Laguvia*.¹

Measurements in millimetres.

| | | | | |
|---------------------------------|----|----|----|------|
| Total length without caudal | .. | .. | .. | 30.0 |
| Length of head | .. | .. | .. | 9.0 |
| Depth of head | .. | .. | .. | 4.5 |
| Width of head | .. | .. | .. | 8.0 |
| Height of body | .. | .. | .. | 7.0 |
| Length of snout | .. | .. | .. | 5.0 |
| Diameter of eye | .. | .. | .. | 1.0 |
| Interorbital width | .. | .. | .. | 2.5 |
| Length of caudal peduncle | .. | .. | .. | 5.5 |
| Least height of caudal peduncle | .. | .. | .. | 3.0 |
| Longest ray of dorsal fin | .. | .. | .. | 6.0 |
| Length of pectoral fin | .. | .. | .. | 5.5 |
| Length of ventral fin | .. | .. | .. | 4.0 |
| Length of caudal fin | .. | .. | .. | 8.0 |

¹ Hora, S. L., *Rec. Ind. Mus.*, XXII, p. 739 (1921).

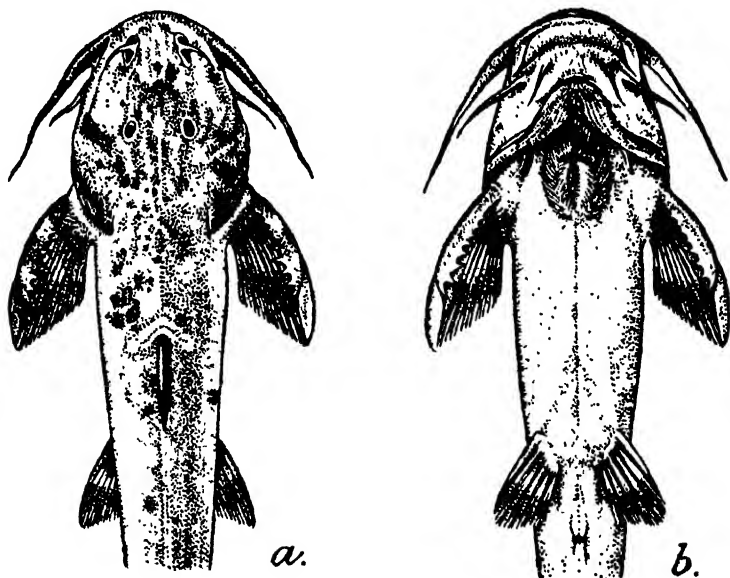
Glyptothorax burmanicus, sp. nov.

(Plate VII, fig. 3.)

D. 1/6, A. 2/9, P. 1/8, V. 1/5, C. 21.

The dorsal profile to the origin of the dorsal fin is moderately curved and almost straight behind it. The ventral profile is more or less straight up to the insertion of the anal fin. The head is longer than broad and about twice as broad as deep; its length is contained about 3.5 times and the depth of the body about 5.5 times in the length of the body without the caudal. The snout is broadly rounded anteriorly and is slightly longer than the postorbital part of the head. The eyes are small, superior, and situated in the posterior half of the head; their diameter is contained 14 times in the length of the head. The interorbital width is equal to the distance between the anterior margin of the orbit and the openings of the posterior nostrils.

There are four pairs of barbels. The nasals are about as long as the distance between their bases. The maxillary barbels are broad at their bases and extend to the base of the pectoral spine. The outer mandibular pair are half as long as the maxillary, while the inner pair are much shorter.

TEXT-FIG. 5.—*Glyptothorax burmanicus*, sp. nov.

(a) Dorsal view of anterior portion of body of type-specimen, nat. size.

(b) Ventral view of anterior portion of body of the same, nat. size.

The upper jaw is considerably longer than the lower. The mouth is inferior, and the width of the gape is equal to the length of the snout. The teeth are minute and sharp, and are arranged in a broad patch in the upper jaw. In the lower jaw they are placed on a crescentic band which

is divided in the middle by a narrow fleshy projection of the skin. The anterior lip is papillated, while the posterior is more or less smooth. The adhesive apparatus on the thorax is well-developed, more or less rhomboidal in shape and longer than broad and has a deep depression in the centre (fig. 5b). The anus is situated nearer to the base of the anal fin than to that of the ventrals, and is provided with a papilla behind it.

The dorsal fin is inserted just above the middle of the distance between the points of origins of the pectorals and the ventrals. The dorsal spine is fairly strong and is as long as the postorbital part of the head, while the longest dorsal ray is shorter than the depth of the body. The pectorals are as long as the head from behind the opening of the posterior nostril. The pectoral spine is flat, strongly denticulated behind, and is devoid of any adhesive apparatus on its ventral surface. The ventrals are nearly $\frac{3}{4}$ the length of the pectoral and extend beyond the anal opening. They are situated about in the middle of the distance between the first dorsal ray and the commencement of the adipose dorsal. The anal fin, which commences slightly behind the insertion of the adipose dorsal, is nearly as long as the pectorals. The adipose dorsal is about 4 times as long as high and its base is nearly $1\frac{1}{2}$ times longer than that of the anal. The caudal fin is slightly longer than the pectorals; it is deeply emarginate, both the lobes being equal and pointed.

The colour of the type-specimen in spirit is dusky brown above with many blackish spots irregularly scattered over the body. The lower surface is dirty yellowish. The fins are banded.

Only a single specimen of this new species was collected from Sankha, a large hill-stream, midway between Kamaing and Mogaung, in the Myitkyina District.

Type-specimen.—No. F.10877/1 in the collection of the Zoological Survey of India (*Ind. Mus.*), Calcutta.

Remarks.—In his revision of the genus *Glyptothorax*, Hora¹ has discussed in detail the specific positions of the different species of the genus and has given a key to the Indian forms. According to this key all the species in which the pectoral spine and the ventral rays are not plaited below, and in which the longest ray of the dorsal fin is as long as or shorter than the depth of the body, can be grouped into two main divisions, viz. :

“A. Pectorals as long as or slightly longer than length of head; thoracic adhesive apparatus slightly longer than broad and provided with a depression in its centre”; . . . and “B. Pectorals shorter than length of head; thoracic adhesive apparatus considerably longer than broad and devoid of a depression in its centre.” (Italics are ours). *Glyptothorax burmanicus* is a very characteristic species and cannot be placed in either the first or the second division for it differs from the former in its shorter pectorals and from the latter in its having a deep depression in the centre of the thoracic adhesive apparatus. Its main distinguishing

¹ Hora, S. L.—*Rec. Ind. Mus.*, XXV, pp. 8-30 (1923).

features are the short pectorals, *i.e.*, shorter than length of head and a deep depression in the middle of the thoracic adhesive apparatus.

Measurements in millimetres.

| | | | | |
|---------------------------------|----|----|----|-------|
| Total length without caudal | .. | .. | .. | 104.0 |
| Length of head | .. | .. | .. | 28.0 |
| Depth of head | .. | .. | .. | 12.0 |
| Width of head | .. | .. | .. | 23.0 |
| Height of body | .. | .. | .. | 19.0 |
| Length of snout | .. | .. | .. | 15.0 |
| Diameter of eye | .. | .. | .. | 2.0 |
| Interorbital width | .. | .. | .. | 6.0 |
| Length of caudal peduncle | .. | .. | .. | 20.0 |
| Least height of caudal peduncle | .. | .. | .. | 8.0 |
| Longest ray of dorsal fin | .. | .. | .. | 15.0 |
| Length of pectoral fin | .. | .. | .. | 20.0 |
| Length of ventral fin | .. | .. | .. | 14.0 |
| Length of caudal fin | .. | .. | .. | 21.5 |

Erethistes conta (Ham. Buch.).

1822. *Pimelodus conta*, Hamilton Buchanan, *Fish. Ganges*, pp. 191, 378.

1860. *Hara filamentosa*, Blyth, *Journ. Asiat. Soc. Bengal*, XXIX, p. 152.

1864. *Hara conta*, Günther, *Cat. Fish. Brit. Mus.*, V, p. 189.

1877. *Erethistes conta*, Day, *Fish. India*, p. 453, pl. cii, fig. 4.

1889. *Erethistes conta*, Day, *Faun. Brit. Ind., Fish.* I, p. 205.

1889. *Erethistes conta*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 250.

Day's description of the pectoral spine of this species as "rather shorter than the head" is incorrect. We have very carefully measured specimens of *E. conta* from Tenasserim sent by Major Berdmore, Day's specimens from Bassein in the Indian Museum collection and the present specimen from the Indawgyi Lake, and find that the dorso-ventrally flattened pectoral spine, which is denticulated internally and serrated externally, is slightly curved backwards and is considerably longer than the head or the dorsal spine.

Further, according to Day, the "colouration of *E. conta* is similar to that of *E. hara*, except that the mandibular barbels do not appear ever to be annulated with black and sometimes even the maxillary pair are destitute of colour." But, as was stated by Hamilton Buchanan in the original description of the species and shown in his unpublished figure of *Pimelodus khongta*, No. 17, both the maxillary and the mandibular barbels of *E. conta* are distinctly annulated with black.

Only a single specimen of *E. conta* was collected from the south end of the Indawgyi Lake. It is 59 mm. long.

Family HOMALOPTERIDAE.

In discussing the Indian members of the family Homalopteridae, Hora¹ recognized three genera: *Homaloptera* van Hasselt with *Helgia* Vinciguerra as a synonym, *Balitora* Gray and Hardwicke and *Bhavanina*²

¹ Hora, S. L.—*Rec. Ind. Mus.*, XIX, pp. 195-207 (1920).

² Hora's selection of the name *Bhavanina* is rather unfortunate owing to a very similar name having been used by Schmarda for a Polychaete *Bhavanina* in *Neue Wirbellose Thiere*, I, ii, p. 164 (1861). The different spellings of the two names, however, allow of their being retained.

Hora. The two latter of these three genera are endemic in India only, while *Homaloptera* has a wide range in the south-eastern parts of the Asiatic continent and in the Indo-Australian Archipelago.

The first point to be considered is the validity of the generic name *Balitora* and the author or authors to whom it should be assigned. Hora in the paper cited above assigns the genus to Gray and Hardwicke, but the "Illustrations of Indian Zoology,"¹ in which the name was first used in a scientific sense, was edited by Gray alone. It was based on the collections of Natural History specimens and drawings of Major-General Hardwicke, but was not the joint work of Gray and Hardwicke. This is clearly proved by Gray being cited as the editor of the work, and, further, by all the new species in the 'Directions for arranging the Plates' at the end of the work being referred to as Gray's species; on the plates only the names of the fishes are given and the authors of the various species are not cited. No descriptions of the plates or of the new genera and species illustrated were ever published by Gray, and this in many cases has resulted in confusion as to their author. Confining ourselves to the fishes under question, we find that the first confusion was started by Swainson in 1838.² He published poor copies of Gray's figures of *Balitora brucei* (misspelt *Bricei* by Swainson) and added the following short description: "its living in mountain streams, joined to its single dorsal fin, small scales, and general habit, sanctions the idea that it enters within the confines of the family *Cobitidæ*, of which it forms the platyrostral or cartilagenous type." Incomplete, inaccurate and altogether inadequate as this description is for the identification of the genus and Gray's species, it may with the figures, for the purpose of the Rules of Zoological Nomenclature, be accepted as the first description of the genus *Balitora*, and *B. brucei*, the only species mentioned, be taken as its genotype. McClelland³ rightly assigned the genus and the species to Gray, but changed the generic name to *Platycara* as "for independently of the species being different from any of those described by Buchanan, and supposed by him to be the *Balitora* of natives, Mr. Gray's genus is peculiar to mountain torrents, the beds of which are rocky rather than sandy; for this reason as well as from the fact of the *Balitora* of Gray forming a new type distinguished by a flat head and other remarkable characters, I propose for it the generic name *Platycara*." McClelland gave a fairly complete description of the genus, but included in it *Platycara nasuta*, which, as we know now, is a species of the genus *Garra*.

Günther⁴ in including *Balitora* in the synonymy of the genus *Homaloptera* added that the generic name *Balitora* of Gray was "not characterized." Though assigning the generic name to Gray, Günther curiously assigned the two Indian species of the genus to Gray and Hardwicke; his references to the plate in Gray's work are also inaccurate. Day⁵ followed Günther in reference to the authors of the genus and the species.

¹ For dates of publication see Sherborn "Index Animalium," p. lxi.

² Swainson, W.—*Nat. Hist. Class. Fishes, Amphibia, Reptiles in Lardner's Cabinet Cyclopædia*, I, pp. 366, 367 (London, 1838).

³ McClelland, J.—*Asiat. Researches*, XLX, pp. 245, 246, 269, 427, 428 (1839).

⁴ Günther, A.—*Cat. Fish. Brit. Mus.*, VII, p. 340 (1868).

⁵ Day, F.—*Fishes of India*, pp. 525, 526 (1878), and *Faun. Brit. Ind., Fishes*, I, pp. 243, 244 (1889).

Hora in the paper cited already revived the generic name *Balitora*, and assigned both the genus and its two species to Gray and Hardwicke.

In accordance with the International Rules of Zoological Nomenclature Gray's name *Balitora* has no status (*vide* Opinion 1 (B) in connection with the meaning of the word *Indication* in Art. 25a as applied to generic names). Swainson, however, in spite of his incomplete description, may be accepted as the author of the genus *Balitora*, and in view of Hora's detailed description and revival of the genus, the authors of the genus may be designated as : *Balitora* Swainson *emend.* Hora.

Genus *Chopraia*, nov.

This new genus of the family Homalopteridae, which we associate with the name of Dr. B. N. Chopra, is represented by a large series of specimens. It may be described as follows :

Fish of small size with the head of moderate size, broad, not greatly depressed ; eyes large, situated about the middle of the head and dorso-lateral in position ; mouth large, semicircular, provided with thick fleshy lips, without tubercles ; 6 barbels, 4 in front of the mouth and 2 at the lateral angles. Pectorals and ventrals of normal size, the former with a well developed fleshy peduncle ; pectorals with 14—16 (4—5/10—12) rays and ventrals with 8 (2/6) rays. Branchial openings narrow, extending as far as the anterior margin of the pectoral fin on the ventral surface.

Genotype.—*Chopraia rupicola*, sp. nov. collected from the rocky streams roundabout Kamaing, in the Myitkyina District.

Remarks.—The genus differs from the other genera of the family in the general form, the shape of the head, the situation and better development of the eyes, the branchial openings and the fins. It is very closely allied to *Homaloptera*.

Chopraia rupicola, sp. nov.

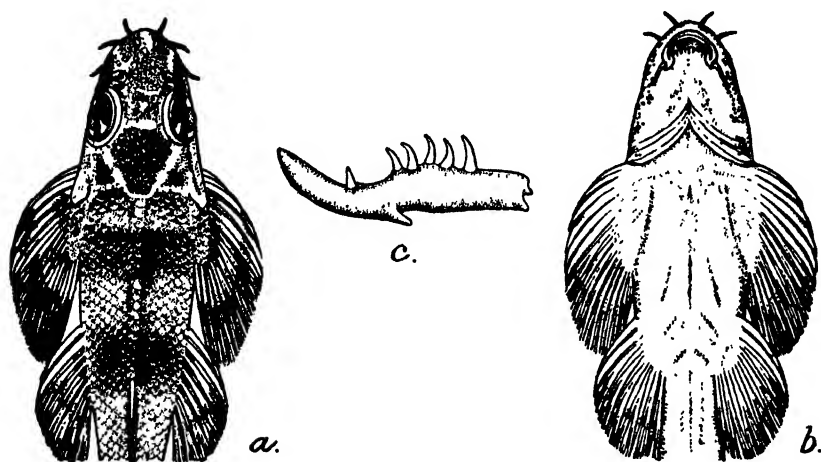
(Plate VIII, fig. 3.)

D. 2/7, A. 2/5, P. 5/11, V. 2/6, C. 27-28, L. 1. 42-45, L. tr. 12.

We have examined a large number of specimens of this species from various rocky streams in the Myitkyina District and can find no differences in the specimens from different streams. The largest specimen before us is 27 mm. long excluding the caudal fin and the species does not seem to grow beyond this size.

The dorsal profile of the fish is moderately arched, the maximum depth being near the origin of the dorsal ; from here the outline slopes gradually to the eyes and then almost abruptly and rapidly to the snout. Behind the dorsal fin the curve is not so marked and the back appears almost straight. The head is almost $\frac{1}{2}$ of the total length of the body excluding the caudal, and its maximum depth is about $\frac{1}{2}$ of its length. The snout is narrowly rounded and is less than $\frac{1}{2}$ the length of the head. The eyes are large, dorso-lateral in position, slightly smaller than the interorbital width and are contained about 4 times

in the length of the head. The mouth is semi-circular, provided with thick fleshy lips ; the upper being better developed and partly over-



TEXT-FIG. 6.—*Chopraia rupicola*, gen. et sp. nov.

- (a) Dorsal view of anterior portion of body of type-specimen, $\times 5\frac{1}{2}$.
- (b) Ventral view of anterior portion of body of the same, $\times 5\frac{1}{2}$.
- (c) Pharyngeal bone with teeth.

hanging the lower. There are no tubercles either on the lips or the area behind the mouth. Of the six barbels, the anterior four are arranged in an arc just outside the upper lip ; the other two arise at the angles of the semi-circular mouth. The pectoral fins are provided with a distinct fleshy peduncle, and almost reach the ventrals. The ventrals are short, about half as long as the pectorals. The caudal fin is only slightly emarginate with the lower lobe slightly longer than the upper. The lateral line is distinct, deeply curved upwards above the pectoral fin, then running almost straight to the base of the caudal fin.

The ground colour is light yellow, with a large number of minute dots of a chocolate to black colour arranged in the form of five vertical bands along the sides. All the fins have 1-2 vertical black bands. In some specimens the bands run into one another, except in the mid-dorsal line, where the light and the dark bands alternate. In spirit specimens the sides of the fish appear of a dark chocolate colour and the abdominal portion is whitish to yellowish.

Distribution.—*C. rupicola* is fairly common in the various rocky and hilly streams of the Myitkyina District. In the collection before us the species is represented from the following streams in the Myitkyina District :—Small rocky streams roundabout Kamaing ; Sankha, a large hill-stream, midway between Kamaing and Mogaung ; Sattan chaung, a stream flowing inside and near the Paudawmu cave about 8 miles from Kamaing ; and small muddy streams along Kamaing Jade Mines Road, in the Myitkyina District.

Type-specimen.—No. F. 10.79/1 in the collection of the Zoological Survey of India (Ind. Mus.), Calcutta, from small rocky streams roundabout Kamaing.

Measurements in millimetres.

| | | | | | | |
|-----------------------------|----|------|------|------|------|------|
| Total length without caudal | .. | 27.0 | 25.0 | 25.0 | 25.0 | 24.0 |
| Height of body | .. | 5.0 | 4.5 | 4.5 | 4.5 | 4.0 |
| Length of head | .. | 7.0 | 6.5 | 6.75 | 6.75 | 6.5 |
| Height of head | .. | 3.5 | 3.25 | 3.5 | 3.25 | 3.25 |
| Width of head | .. | 4.75 | 4.75 | 4.75 | 4.75 | 4.5 |
| Length of snout | .. | 3.0 | 3.0 | 3.0 | 2.75 | 2.75 |
| Diameter of eye | .. | 1.75 | 1.75 | 1.75 | 1.75 | 1.75 |
| Interorbital width | .. | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Height of dorsal fin | .. | 5.25 | 5.0 | 5.25 | 5.25 | 5.0 |
| Length of pectoral fin | .. | 8.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Length of ventral fin | .. | 3.75 | 3.25 | 3.5 | 3.75 | 3.25 |

Balitora Swainson emend. Hora.

1838. *Balitora*, Swainson, *Nat. Hist. Class., Fish. etc.*, I, p. 366.

1920. *Balitora*, Hora, *Rec. Ind. Mus.*, XIX, p. 196.

In the general account of the family we have discussed in detail our reasons for referring the genus *Balitora* to Swainson and Hora rather than to Gray who first suggested the name for the two Indian species.

In the collection from the Indawgyi area there is a single specimen of this genus which we refer to *Balitora brucei* Gray.

***Balitora brucei* Gray.**

1832. *Balitora Brucei*, Gray, *Illustr. Ind. Zoology*, I, pl. lxxxviii, fig. 1.

1920. *Balitora brucei*, Hora, *Rec. Ind. Mus.*, XIX, p. 197.

Hora described this species in detail from old specimens from Cherrapunji and Lower Burma, and so was unable to make any remarks on the natural colouration of the species.

We have examined a fair number of fresh specimens from Tang-Siang stream, Cherrapunji, Assam, collected by Dr. S. L. Hora and a single specimen collected by Dr. B. N. Chopra from Sankha, a large hill-stream midway between Kamaing and Mogaung in the Myitkyina District.

The species is chocolate brown along the sides becoming much lighter on the back. On the dorsum there are a number of circular spots of a brown colour on a lighter background. In some cases these circles run into one another and appear as bands. The fins are light brown with a light yellowish margin. The caudal has two vertical dark bands on a dusky yellow background. The ventral surface is much lighter, being yellowish to white in colour. The lateral line, which is very prominent, appears much lighter in colour than the surrounding area.

The snout is covered by a large number of minute tubercles which extend on the upper surface of the head and on the operculum and even on the fleshy peduncles of the pectoral fins. There is also a prominent semi-circular row of such tubercles above the eye on each side. The tubercles are also present along the fin rays on the upper surface of the pectoral and ventral fins; those on the former being better developed.

In the specimens examined by us there are 3 unbranched rays followed by 8 branched ones in the ventral fins. The number of scales along the lateral line is very variable. In the Burmese specimen there are about 78 scales, while in the Assamese the number does not usually exceed 70.

The only specimen of the species was, as noted above, collected from Sankha hill-stream. It is 36 mm. long.

Family COBITIDAE.

Lepidocephalichthys guntea (Ham. Buch.).

1822. *Cobitis guntea*, Hamilton Buchanan, *Fish. Ganges*, pp. 353, 394.
 1868. *Lepidocephalichthys balgara*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 365.
 1878. *Lepidocephalichthys guntea*, Day, *Fish. India*, p. 609, pl. clv, fig. 4.
 1889. *Lepidocephalichthys guntea*, Day, *Faun. Brit. Ind., Fish. I*, p. 220, fig. 80.
 1889. *Lepidocephalichthys guntea*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 339.
 1913. *Lepidocephalichthys guntea*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 247.
 1921. *Lepidocephalichthys guntea*, Hora, *Rec. Ind. Mus.*, XXII, p. 196.

The species is very scarce in the streams and pools in the district under report and was not found in the Indawgyi Lake.

Only four specimens were collected, two each from a small muddy stream along the Kamaing Jade Mines Road, and small rocky streams roundabout Kamaing, in the Myitkyina District. They are 35 mm. long.

Lepidocephalichthys berdmorei (Blyth).

1860. *Acanthopsis Berdmorei*, Blyth, *Proc. Asiat. Soc. Bengal*, XXIX, p. 168.
 1869. *Cobitis Berdmorei*, Day, *Proc. Zool. Soc., London*, p. 550.
 1878. *Lepidocephalichthys Berdmorei*, Day, *Fish. India*, p. 610, pl. cliii, fig. 3.
 1889. *Lepidocephalichthys berdmorei*, Day, *Faun. Brit. Ind., Fish. I*, p. 221.
 1889. *Lepidocephalichthys Berdmorei*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 341.
 1918. *Lepidocephalichthys berdmorei*, Annandale, *Rec. Ind. Mus.*, XIV, p. 43.
 1921. *Lepidocephalichthys berdmorei*, Hora, *Rec. Ind. Mus.*, XXII, p. 196.

This is the commonest loach in all the muddy and rocky streams and pools in the district under report. It occurs also in the Indawgyi Lake.

Quite a large series of this species was collected from various streams and pools and a few specimens were also found in the lake. The stream and the lake forms are quite similar and do not differ in any particular. The largest specimen from the lake is 75 mm. long.

There appears to be a marked difference in the outlines of the body of *L. guntea* and *L. berdmorei*. In the former species the dorsal outline is more or less straight, while in the latter it is distinctly convex.

Acanthopthalmus pangia (Ham. Buch.).

(Plate VII, fig. 4.)

1822. *Cobitis pangia*, Hamilton Buchanan, *Fish. Ganges*, pp. 355, 394.
 1823. *Acanthopthalmus javanicus*, van Hasselt, *Alg. Konst-en Letterbode*, II, p. 133 (no description).
 1868. *Acanthopthalmus pangia*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 370.
 1878. *Acanthopthalmus pangia*, Day, *Fish. India*, p. 610, pl. clv, fig. 5.
 1889. *Acanthopthalmus pangia*, Day, *Faun. Brit. Ind., Fish. I*, p. 222.
 1889. *Acanthopthalmus pangia*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 347.
 1916. *Acanthopthalmus pangia*, Weber & Beaufort, *Fishes, Indo-Austral-Archipel.* III, p. 31.
 1921. *Acanthopthalmus pangia*, Hora, *Rec. Ind. Mus.*, XXII, p. 197.

The colour of the specimens of this species is reddish-brown above and whitish below. The darker area is mottled with fine dots, and there

are about 20 dark brown vertical bands on the back alternating with lighter ones. At the base of the caudal fin there is generally a blackish vertical band ; another blackish bar runs transversely along the middle from the base to the tip of the caudal fin and a third slightly broader vertical band is present about its middle. The rays of the dorsal fin are all blackish but the other fins are diaphanous.

The largest specimen before us is 35 mm. long. On opening the abdomen egg-masses were found in some of the specimens, which shows that they are adults. Hamilton Buchanan states that his original specimens from East Bengal are " from three to four inches " long. According to Weber and Beaufort *A. pangia* grows to a size of " about 80 mm.", while Hora's largest adult female from Manipur, Assam, is 60 mm. in length.

A. pangia does not occur in the Indawgyi Lake. Quite a large number of specimens were, however, collected from Sankha, a large hill-stream, in the Myitkyina District.

Family CYPRINIDAE.

Garra lamta (Ham. Buch.).

1822. *Cyprinus (Garra) lamta*, Hamilton Buchanan, *Fish. Ganges*, pp. 343, 393.

1921. *Garra lamta*, Hora, *Rec. Ind. Mus.*, XXII, pp. 660-662, pl. xxiv, figs. 2, 2a.

In a recent revision of the species of the genus *Garra*, Hora (*op. cit.*) observed that *Garra lamta* " instead of having a wide range, as stated by a number of authors, is restricted to the eastern part of the Vindhya Range and the Nepal Terai. Buchanan procured some specimens from the Gorakhpur District, probably from the hill-streams." We have to record here its occurrence in Upper Burma also.

The colouration of the Burmese specimen agrees with Hora's description, except that it is slightly darker. Dr. Chopra, in the field notes, observes that in the living specimen " all the fins are tipped with light orange red."

Garra lamta is represented by a single specimen about 45 mm. long, which was collected from Sankha hill-stream in the Myitkyina District.

Labeo calbasu (Ham. Buch.).

1822. *Cyprinus calbasu*, Hamilton Buchanan, *Fish. Ganges*, pp. 297, 307, pl. ii, fig. 83.

1868. *Labeo calbasu*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 54.

1878. *Labeo calbasu*, Day, *Fish. India*, p. 536, pl. cxxvi, fig. 4.

1889. *Labeo calbasu*, Day, *Faun. Brit. Ind., Fish.* I, p. 259, fig. 93.

1889. *Labeo calbasu*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 265.

1911. *Labeo calbasu*, Chaudhuri, *Rec. Ind. Mus.*, VI, p. 23.

1921. *Labeo calbasu*, Hora, *Rec. Ind. Mus.*, XXII, p. 182.

The pectoral fin is almost of the same size as the ventral which does not reach the base of the anal ; the latter extends beyond the base of the caudal.

The living specimens, according to Dr. Chopra's field notes, had " back and sides dark slate grey tinged with greenish ; scales edged with a darker shade of the same. Belly dirty whitish. Lips light orange,"

Two specimens of *L. calbasu* were collected from the western parts of the lake ; the larger of these is 260 mm. long.

Labeo gonius (Ham. Buch.).

1822. *Cyprinus gonius*, Hamilton Buchanan, *Fish. Ganges*, pp. 292, 387, pl. iv. fig. 82.
 1842. *Rohita gonius*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, XVI, p. 301.
 1869. *Labeo gonius*, Day, *Proc. Zool. Soc. London*, p. 372.
 1877. *Labeo gonius*, Day, *Fish. India*, p. 537, pl. cxxvii, fig. 1.
 1889. *Labeo gonius*, Day, *Faun. Brit. Ind., Fish. I*, p. 261.
 1889. *Labeo gonius*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 268.
 1913. *Labeo gonius*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 244.

The interorbital width appears to vary according to the size of the fish. In specimens from 100 to 108 mm. long it is about twice the diameter of the eye, but in larger specimens, say 300 to 400 mm. long, it is nearly $2\frac{1}{2}$ times. The length of the head is contained about 4 times and the depth of the body $3\text{--}3\frac{1}{2}$ times in the total length of the body without the caudal. The lips, specially the upper one, are fringed.

The dorsal fin has 3 unbranched and 15 branched rays. In full-grown specimens the length of the pectoral is equal to that of the head behind the opening of the anterior nostrils, but in younger specimens it is shorter and does not exceed the length of the head behind the snout.

The scales are of a moderate size and arranged in 56-62 rows along the lateral line and 17 rows in a transverse series. Between the lateral line and the base of the ventral there are $7\frac{1}{2}$ scales.

The size, number and arrangement of scales in *L. gonius* seem to be very variable in different localities. Both Day and Vinciguerra have discussed this point at some length, but the question is far from settled and needs a thorough investigation in reference to all the species of the genus.

The living specimens, according to Dr. Chopra's field notes, had "back and head dark green. Longitudinal stripes of the same colour on the sides growing fainter ventrally. About 13 rows of stripes. Belly white. Fins infusate."

L. gonius is fairly common in the lake. Four specimens were collected from the western parts of the lake, the largest of which is about 350 mm. long. It probably grows to a much larger size and is one of the chief edible fish in the Myitkyina District.

Labeo rohita (Ham. Buch.).

1822. *Cyprinus rohita*, Hamilton Buchanan, *Fish. Ganges*, pp. 301, 388, pl. xxxvi, fig. 85.
 1842. *Labeo Dussumieri* & *L. fimbriatus*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, XVI, pp. 350, 353.
 1868. *Labeo rohita*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 55.
 1877. *Labeo rohita*, Day, *Fish. India*, p. 533, pl. cxxvii, fig. 4.
 1889. *Labeo rohita*, Day, *Faun. Brit. Ind., Fish. I*, p. 262.

The dorsal fin is situated nearer the tip of the snout than the base of the caudal fin. The pectoral is as long as the head behind the opening of the posterior nostrils. The ventral is slightly longer than the pectoral. The anal extends beyond the base of the caudal fin.

According to Dr. Chopra's field notes the living specimens of *L. rohita* had the "dorsal surface greyish black, sides silvery greyish.

Five or six rows of orange red spots on the sides. Belly white. Eyes blackish grey encircled with bright red. Fins dark greyish. The orange spots on the sides are very conspicuous."

L. rohita is fairly common in the lake and the rivers and is said to grow to a weight of about 25 to 30 lbs.

Two specimens were collected, one from the lake and the other from the rivers flowing into it. The lake example is about 300 mm. long and does not differ in any way from the river form.

Labeo angra (Ham. Buch.).

1822. *Cyprinus angra*, Hamilton Buchanan, *Fish. Ganges*, pp. 331, 391.
 1868. *Labeo morala*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 56.
 1877. *Labeo angra*, Day, *Fish. India*, p. 541, pl. cxxviii, fig. 2.
 1889. *Labeo angra*, Day, *Faun. Brit. Ind., Fish.* I, p. 267.
 1889. *Labeo angra*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 273.
 1913. *Labeo angra*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 249.
 1921. *Labeo angra*, Hora, *Rec. Ind. Mus.*, XXII, p. 183.

The specimens from Myitkyina District agree with the typical Burmese examples of *L. angra*.

Two specimens were collected from the Namkawng *chaung* at Kamaing in the Myitkyina District, where it is very common. The specimens vary from 210 to 250 mm. in length.

According to Dr. Chopra's field notes the bottom of the stream from which the specimens were collected "is partly muddy and partly sandy, and the water is quite clear. The flow is not rapid."

Labeo boga (Ham. Buch.).

1822. *Cyprinus boga*, Hamilton Buchanan, *Fish. Ganges*, pp. 280, 386, pl. xxviii, fig. 80.
 1877. *Labeo boga*, Day, *Fish. India*, p. 543, pl. cxxviii, fig. 3 & pl. cxxxi, fig. 4.
 1889. *Labeo boga*, Day, *Faun. Brit. Ind., Fish.* I, p. 269.
 1889. *Labeo boga*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 274.

The specimens of this species in the collection before us agree in all respects with the Burmese examples in the Indian Museum collection. There are large open pores on the snout. The scaly appendage of the ventral fin is long and well developed. A dark spot is present above the middle of the pectoral fin.

No specimens of *L. boga* were collected from the lake itself, but two were procured from the Namkawng *chaung* at Kamaing, in the Myitkyina District. The larger of the two is 200 mm. long.

Cirrhitina mrigala (Ham. Buch.).

1822. *Cyprinus mrigala*, Hamilton Buchanan, *Fish. Ganges*, pp. 279, 386, pl. vi, fig. 79.
 1842. *Cirrhitina rubripinnis*, Cuvier & Valenciennes, *Nat. Hist. Poisson*, XVI, p. 288, pl. cccclviii.
 1842. *Cirrhitina mrigala*, Cuvier & Valenciennes, *Nat. Hist. Poisson*, XVI, p. 294.
 1868. *Cirrhitina mrigala*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 35.
 1871. *Cirrhitina mrigala*, Day, *Journ. Astat. Soc. Bengal*, p. 135, pl. ix, figs. 6a, 6b.
 1877. *Cirrhitina mrigala*, Day, *Fish. India*, p. 547, pl. cxxix, fig. 4.
 1889. *Cirrhitina mrigala*, Day, *Faun. Brit. Ind., Fish.* I, p. 278.
 1889. *Cirrhitina mrigala*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 261.
 1910. *Cirrhitina mrigala*, Jenkins, *Rec. Ind. Mus.*, V, p. 138.
 1911. *Cirrhitina mrigala*, Chaudhuri, *Rec. Ind. Mus.*, VI, p. 24.

Small pores are present on the snout. The pectoral fin is nearly as long as the head including the snout. The ventral is as long as the pec-

toral. A pair of rostral barbels is present ; they are about half the width of the orbit. These barbels, which were noticed by Hamilton Buchanan, are not mentioned in Day's description of the species but are shown in his figure.

C. mrigala seems to be rare in the lake itself, but is very common in the Indaw River and Namkawng *chaung* at Kamaing in the Myitkyina District. It is said to grow to a weight of about 20 lbs.

One specimen 250 mm. in length was obtained from the Namkawng *chaung*.

Catla catla (Ham. Buch.).

1822. *Cyprinus calla*, Hamilton Buchanan, *Fish. Ganges*, pp. 287, 318, pl. xiii, fig. 81.

1844. *Calla Buchanani*, Cuvier & Valenciennes, *Nat. Hist. Poisson*, XVII, p. 411, pl. 515.

1868. *Calla Buchanani*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 14.

1878. *Calla Buchanani*, Day, *Fish. India*, p. 553, pl. cxxxiv, fig. 5.

1889. *Calla buchani*, Day, *Faun. Brit. Ind., Fish. I*, p. 287, fig. 99.

1889. *Calla Buchanani*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 260.

1916. *Calla catla*, Sundara Raj, *Rec. Ind. Mus.*, X11, p. 254.

1923. *Calla catla*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 158.

The pectoral fin does not reach the base of the ventral, nor does the ventral extend to the anal. All the fins are darkish.

C. catla is a very common fish in the northern area of the lake, and grows to about 15 to 20 lbs. in weight. The local fishermen consider it to be the "best" of all the edible fishes of the lake.

One specimen 265 mm. long was obtained from the lake.

Amblypharyngodon atkinsonii (Blyth).

1860. *Mola Atkinsonii*, Blyth, *Journ. Asiat. Soc. Bengal*, XXIX, p. 164.

1878. *Amblypharyngodon Atkinsonii*, Day, *Fish. India*, p. 555, pl. cxxxiv, fig. 4.

1889. *Amblypharyngodon atkinsonii*, Day, *Faun. Brit. Ind., Fish. I*, p. 290.

1889. *Amblypharyngodon Atkinsonii*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 302.

The lower jaw has a slightly elevated, knob-like structure in the middle, and there is a corresponding emargination in the upper jaw for this projection of the lower jaw.

The opercular bones are silvery ; dorsal, caudal and anal fins are tipped with black ; and generally a greyish transverse band is present on the sides of the body.

A. atkinsonii was not found in the lake. It is represented in the collection by six specimens which were collected from the Namkawng *chaung* at Kamaing, in the Myitkyina District. They are all about 100 mm. long.

Barbus chagunio (Ham. Buch.).

1822. *Cyprinus chagunio*, Hamilton Buchanan, *Fish. Ganges*, pp. 295, 387.

1839. *Barbus chagunio*, McClelland, *Asiat. Research*. XIX (2), pp. 272, 341, pl. ix, fig. 4.

1868. *Barbus spilopholis* & *B. Beavani*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 96.

1878. *Barbus chagunio*, Day, *Fish. India*, p. 559, pl. cxxxvi, fig. 1 & pl. cxi, fig. 2.

1889. *Barbus chagunio*, Day, *Faun. Brit. Ind., Fish. I*, p. 299.

1913. *Barbus chagunio*, Hora, *Rec. Ind. Mus.*, VII, pp. 250, 251.

1928. *Barbus chagunio*, Hora, *Journ. Asiat. Soc. Bengal*, XXIII, pp. 415-417.

As none of the published description of *B. chagunio* are complete we give below a short description. Besides the two well preserved speci-

mens from Upper Burma we have examined a large series of this species preserved in the collections of the Indian Museum.

D. 5/8, A. 3/5, P. 15, V. 2/8, C. 19, L. 1.46-47, L. tr. 14.

The head is considerably compressed, its width in the middle being equal to half its own length. The eyes are situated almost in the middle of the head and their diameter is about 4 times in the length of the head. They are situated $1\frac{1}{2}$ -2 diameters from the tip of the snout and the inter-orbital distance is slightly longer than their diameter.

The dorsal fin is inserted slightly in advance of the ventral and is nearer the tip of the snout than the base of the caudal. The pectoral is as long as the length of the head behind the opening of the nostrils or is slightly longer, and is separated from the base of the ventral by a distance which equals almost half its own length. The ventral is considerably shorter than the pectoral, and its first unbranched ray is very small and firmly attached to the second one. The anal fin originates midway between the ventrals and the base of the caudal. Its longest branched ray is as long as the head, excluding the snout. The vertical fins are scaly at their bases and the ventrals have well developed scaly appendants.

The maxillary and the rostral barbels are almost equal in length ; only the latter are more slender.

The colouration of the specimens in spirit is silvery glossed with gold and, as Day observes, the scales towards the back are "darkest at their bases." The distal portion of the dorsal fin is black. There is a blackish band just behind the operculum which passes from the base of the pectoral to the nape.

Distribution.—*B. chagunio* has been recorded from "Orissa, throughout Bengal, Assam, Bihar and the N. W. Provinces to the Punjab," but has not so far been found in "Sind, the Deccan, Western Coast, Mysore, Madras or Burma."

This species is fairly common in the Namkawng *chaung* at Kamaing in the Myitkyina District, though only two specimens were brought back by Dr. Chopra.

Remarks.—In his recent note Hora has discussed at length the Günther-Day controversy about the specific validity of Hamilton Buchanan's *Cyprinus chagunio* and concludes that in Hamilton Buchanan's manuscript notes the number of rays in the dorsal fin is given as "D. 11" and this should be the distinguishing factor in the identity of his species *B. chagunio*.

We have carefully examined a large series of specimens from various areas and prepared the skeleton of the dorsal fin of one specimen, and find that the number of dorsal fin rays is not 11, as stated by Hamilton Buchanan, but that there are 13 definite rays, of which 5 are spinous and 8 branched. The first two spinous rays are very small and embedded in the skin and are, therefore, likely to be overlooked when the fish is not carefully examined.

Measurements in millimetres.

| | | | | |
|---------------------------------|----|----|-------|-------|
| Total length without caudal | .. | .. | 210.0 | 195.0 |
| Length of head .. | .. | .. | 48.0 | 45.0 |
| Height of body .. | .. | .. | 65.0 | 60.0 |
| Length of snout.. | .. | .. | 18.0 | 17.0 |
| Diameter of eye.. | .. | .. | 12.0 | 11.0 |
| Interorbital width | .. | .. | 13.0 | 13.0 |
| Length of caudal peduncle .. | .. | .. | 35.0 | 35.0 |
| Least height of caudal peduncle | .. | .. | 24.0 | 22.0 |
| Length of pectoral fin | .. | .. | 38.0 | 35.0 |
| Length of ventral fin | .. | .. | 30.0 | 29.0 |

***Barbus sewelli*, sp. nov.**

(Plate IX, figs. 1, 1a, 1b).

D. 4/8, A. 3/6, P. 16, V. 9, C. 24-26, L. 1. 32-36, L. tr. 10 ($5\frac{1}{2}+4\frac{1}{2}$).

The length of the head is contained from 3.4 to 3.7 times and the depth of the body from 2.3 to 2.5 times in the total length of the body without the caudal. The diameter of the eye is contained from 3.4 to 3.8 times in the length of the head. The snout is slightly longer than the diameter of the eye and is contained about 1.3 times in the interorbital width.

The dorsal fin commences midway between the tip of the snout and the base of the caudal fin. The last dorsal spine is fairly strong and is denticulated in its distal posterior half. The pectorals are slightly longer than the ventrals and are separated from the base of the latter by a distance equalling $\frac{1}{3}$ of their length. The ventrals are inserted just below the origin of the dorsal; they do not extend to the base of the anal. The caudal fin is deeply emarginate. The dorsal, anal and the caudal fins have scales at their bases.

The scales are large. There are 10 or 11 predorsal scales. The lateral line is complete.

There are two pairs of barbels. The maxillary barbels are situated at the angles of the mouth and are almost equal to or slightly longer than the diameter of the eye. The rostrals originate midway between the angles of the mouth and the tip of the snout. They are nearly $\frac{2}{3}$ of the length of the maxillary barbels, and for the greater part of their length are covered up by the fleshy labial fold. The occipital region is more or less flat and the snout is moderately pointed.

In the field notes, the colour of fresh specimens was noted as "back and head olivaceous green colour extending to sides. Belly and sides silvery white. 8 longitudinal rows of black spots, from back of the operculum to the base of the caudal. A large black blotch at the posterior end of the operculum. Orbit gold on sides, black above. An olive coloured streak in front of the orange spot on the operculum. All fins are tipped with orange red, the coloured area in the case of caudal and anal being considerably more than half of the fin."

In the spirit specimens the upper half of the body is pinkish-blue in colour and the ventral half is yellowish-white. There are 8 rows of prominent black spots on the sides, each spot being situated at the free portion of the successive scales. These spots are regularly arranged

in longitudinal series which run more or less parallel to one another from behind the operculum to the base of the caudal fin. There is a deep black band just behind the operculum from its upper angle to the base of the pectoral fins. An indistinct blackish blotch is also present in the middle of the caudal peduncle. The dorsal and the pectoral fins are dusky, and the ventrals and the anal are yellowish-white. The outer marginal rays of the caudal are more or less blackish.

B. sewelli is fairly common in the Indawgyi Lake, especially in the south-western area. It is said to grow to a moderate size, usually not exceeding 8-9 inches.

Seven specimens were collected from the southern area of the lake and along its western shore near Lonton village and two from the northern end near Nyaungbin village, in the Myitkyina District. The largest example is 110 mm. long excluding the caudal.

Type-specimen.—No. F.10910/1 in the collection of the Zoological Survey of India (*Ind. Mus.*), Calcutta.

Measurements in Millimetres.

| | | | |
|---------------------------------------|-------|------|------|
| Total length without caudal | 108.0 | 99.0 | 90.0 |
| Length of head | 29.0 | 27.0 | 24.0 |
| Height of body | 42.5 | 42.0 | 35.0 |
| Length of snout | 9.0 | 8.0 | 7.5 |
| Diameter of eye | 8.0 | 7.0 | 7.0 |
| Interorbital width | 12.0 | 11.0 | 10.0 |
| Length of caudal peduncle | 22.0 | 21.0 | 18.0 |
| Least height of caudal peduncle | 21.0 | 19.0 | 16.0 |
| Length of pectoral fin | 22.0 | 20.0 | 18.3 |
| Length of ventral fin | 15.0 | 14.0 | 13.0 |

***Barbus myitkyinae*, sp. nov.**

(Plate IX, figs. 2, 2a, 2b.)

D. 4/8, A. 3/6, P. 15, V. 9, C. 26-28, L. 1. 32-34, L. tr. 9 ($5\frac{1}{2}+3\frac{1}{2}$).

The length of the head is contained from 4.1 to 4.5 times and the depth of the body from 2.7 to 3.1 times in the total length of the body without the caudal. The diameter of the eye is almost equal to the length of the snout and is contained from 3.2 to 3.8 times in the length of the head. The length of the snout is equal to or slightly longer than the interorbital width.

The dorsal fin is inserted midway between the tip of the snout and the base of the caudal fin and is emarginate at the free margin. The last undivided dorsal ray is very strong and denticulated internally; it is as long as the head up to or slightly beyond the opening of the nostrils. The pectorals are almost as long as the ventrals and do not extend to the base of the latter. The ventrals commence just below the dorsal and are separated from the base of the anal by a distance equalling about half their own length. The anal fin is rather short. The caudal is deeply forked. The dorsal, the anal and the caudal are enclosed at their bases in scaly sheaths.

The scales are large. There are 11 or 12 scales before the dorsal fin. The lateral line is complete.

There are two pairs of barbels. The maxillary barbels are shorter than the diameter of the eye, while the rostrals are about half as long. The interorbital portion is flat and the snout is obtusely pointed.

In spirit specimens, the body in the upper half is greenish-black, while the portion below the lateral line and the opercular region are silvery. There is a black vertical band just behind the gill-opening. The free margins of the scales are bordered with minute blackish dots. All the fins are dirty whitish.

B. myitkyinae is quite common in the Indawgyi Lake and in streams in the adjacent area. In the lake it is said to grow to about 4 lbs. in weight.

A large series of specimens of this fish was collected from different parts of the lake. The largest example from the western area of the lake is 270 mm. in length excluding the caudal.

Type-specimen.—No. F. 10912/1 in the collection of the Zoological Survey of India (*Ind. Mus.*), Calcutta.

Remarks.—*B. myitkyinae* is characterised by the number of transverse rows of scales of which there are $5\frac{1}{2}$ above the lateral line, by its deep and somewhat compressed body, and a comparatively small head and big eyes for a fish of this size. Of the known species of the genus *Barbus* from Burma it appears to be closely allied to *B. oatesii* Boulenger¹, but the points mentioned above distinguish it without any difficulty.

Measurements in millimetres.

| | | | |
|---------------------------------------|-------|-------|-------|
| Total length without caudal | 270.0 | 135.0 | 127.0 |
| Length of head | 60.0 | 32.5 | 30.0 |
| Height of body | 85.0 | 49.0 | 46.0 |
| Length of snout | 16.0 | 10.0 | 9.0 |
| Diameter of eye | 15.5 | 10.0 | 9.0 |
| Interorbital width | 15.5 | 10.0 | 8.5 |
| Length of caudal peduncle | 42.0 | 26.0 | 25.0 |
| Least height of caudal peduncle | 31.0 | 18.0 | 16.0 |
| Length of pectoral fin | 47.0 | 28.0 | 26.0 |
| Length of ventral fin | 48.0 | 28.0 | 25.5 |

Barbus sarana caudimarginatus Blyth.

1860. *Barbus caudimarginatus*, Blyth, *Journ. Asiat. Soc. Bengal*, XXIX, p. 157.

1918. *Barbus sarana caudimarginatus*, Annandale, *Rec. Ind. Mus.*, XIV, p. 46, pl. iii, fig. 3.

1921. *Barbus sarana caudimarginatus*, Hora, *Rec. Ind. Mus.*, XXII, p. 183.

Annandale has rightly remarked that "this form is no more than a Burmese race of the common Indian *B. sarana* (Ham. Buch.) differing only in colouration and in possessing more variable number of lateral scales."

In *B. sarana caudimarginatus* there are from 28 to 30 scales along the lateral line, whereas in the typical *B. sarana* the number is generally 32 to 34. The number of scales between the lateral line and the base of the ventral fin is always $3\frac{1}{2}$ to $4\frac{1}{2}$ in the typical Indian form.

¹ Boulenger, G. A.,—*Ann. Mag. Nat. Hist.* (6) XII, p. 201 (1893).

B. sarana caudimarginatus is fairly common in the Indawgyi Lake, especially in the shallow waters in the southern and western areas. It is said to grow to about one foot in length.

A large number of specimens of this species were collected by Dr. Chopra and his party from the areas mentioned above. The largest of these specimens is 130 mm. long.

***Barbus hexastichus* McClelland.**

1839. *Barbus hexastichus*, McClelland, *Asiat. Research.*, XIX (2), pp. 269, 333, pl. xxxix, fig. 2.

1868. *Barbus hexastichus*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 129.

1878. *Barbus hexastichus*, Day, *Fish. India*, p. 565, pl. cxxxvi, fig. 4.

1899. *Barbus hexastichus*, Day, *Faun. Brit. Ind., Fish.* I, p. 308.

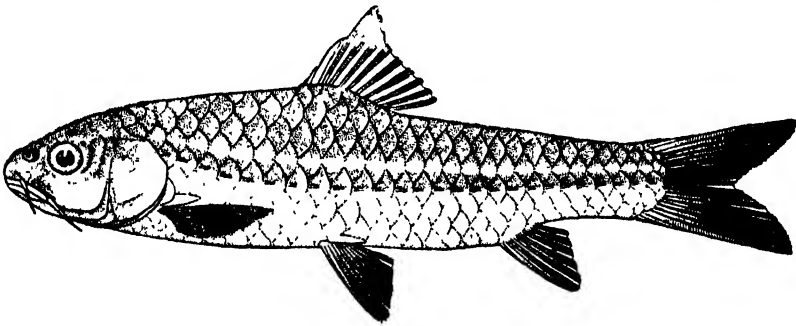
1889. *Barbus hexastichus*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 293.

1913. *Barbus hexastichus*, Chaudhuri, *Rec. Ind. Mus.*, VII, p. 249.

1921. *Barbus hexastichus*, Hora, *Rec. Ind. Mus.*, XXII, p. 186.

1924. *Barbus hexastichus*, Hora, *Rec. Ind. Mus.*, XXVI, p. 27.

The maxillary barbels are longer than the rostrals and are about $1\frac{1}{2}$ times the diameter of the eyes. The lips are well developed and more



TEXT-FIG. 7.—Lateral view of *Barbus hexastichus* McClell. from Myitkyina District, $\times \frac{2}{3}$

or less fleshy. The interorbital width is about twice the diameter of the eye in full-grown specimens. The breadth of the head is almost equal to its length behind the middle of the orbit. The depth of the body is equal to the length of the head or even slightly more.

The dorsal fin is inserted just above the ventrals in full-grown specimens, but in younger individuals it is situated slightly in front; it consists of 4 spines and 9 branched rays. The pectoral fin is as long as the head behind the opening of the nostrils or even slightly longer; it does not extend up to the ventrals.

The scales for a fish of this size are particularly large. There are 25 scales in a longitudinal row, 6 in each transverse row and $2\frac{1}{2}$ rows between the lateral line and the base of the ventrals. There are 9 to 10 predorsal scales. The caudal peduncle is nearly $1\frac{1}{2}$ times longer than high.

The colour of the specimens in spirit is blackish in the upper half of the body, while the lower half is silvery white. The rostral barbels and the fins are dusky.

According to Dr. Chopra's field notes, *B. hexastichus* is "very common in deep pools in front of the cave mouth (Paudawmu cave) and just inside the entrance. Lower half light pinkish when living. Scales in the upper

half dull grey with prominent patches of yellowish red; in lower half silvery white edged with light pink. Lips reddish. Anal fin pinkish, others, especially the pelvic and the caudal, edged with pink. Eyes sky bluish. Grows to about 25 to 30 lbs. in weight. Much commoner in the rivers than in the lake."

In the collection there are three specimens, two large ones from Kamaing and a medium sized one from the Sattan *chaung* inside and near Paudawmu cave, about 8 miles from Kamaing in the Myitkyina District. The largest specimen is 400 mm. long.

Barbus chola (Ham. Buch.).

1822. *Cyprinus chola*, Hamilton Buchanan, *Fish. Ganges*, pp. 312, 389.
 1868. *Barbus chola*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 143.
 1878. *Barbus chola*, Day, *Fish. India*, p. 571, pl. cxlii, fig. 4.
 1889. *Barbus chola*, Day, *Faun. Brit. Ind., Fish.* I, p. 317.
 1889. *Barbus chola*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 294.
 1907. *Barbus chola*, Annandale, *Rec. Ind. Mus.*, I, p. 41.
 1911. *Barbus chola*, Chaudhuri, *Rec. Ind. Mus.*, VI, p. 15.
 1913. *Barbus chola*, Chaudhuri, *Rec. Ind. Mus.*, VII, p. 249.

The deep black precaudal spot and the black mark behind the gill-opening, which were considered by Day to be characteristics of individuals of the species from Bengal and Assam only, are present in all the specimens before us. In specimens of moderate size there is generally a narrow blackish band across the middle of the dorsal fin, but in the younger specimens it is represented by only a black blotch in the anterior part of the fin. There are 25-26 scales in a longitudinal row.

B. chola occurs in the lake in very large numbers and appears to be the commonest of all the lake-dwelling species of the genus *Barbus*.

A large series of specimens of the species were collected by Dr. Chopra and his party from different parts of the lake and various streams in that part of the country.

Barbus burmanicus Day.

1878. *Barbus burmanicus*, Day, *Fish. India*, p. 572, pl. cxli, fig. 4.
 1889. *Barbus burmanicus*, Day, *Faun. Brit. Ind., Fish.* I, p. 318.
 1889. *Barbus burmanicus*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 295.

Only a single young specimen of *B. burmanicus* was obtained from a shallow and sluggish hill-stream at Hopin, in the Myitkyina District. It is 40 mm. long.

Barbus phutunio (Ham. Buch.).

1822. *Cyprinus phutunio*, Hamilton Buchanan, *Fish. Ganges*, pp. 319, 390.
 1868. *Barbus phutunio*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 154.
 1869. *Barbus phutunio*, Day, *Proc. Zool. Soc. London*, p. 375.
 1878. *Barbus phutunio*, Day, *Fish. India*, p. 578, pl. cxlv, fig. 4.
 1889. *Barbus phutunio*, Day, *Faun. Brit. Ind., Fish.* I, p. 327.
 1912. *Barbus phutunio*, Sewell & Chaudhuri, *Ind. Fish of Prov. Util. etc.*, p. 15, fig. 8.
 1921. *Barbus phutunio*, Hora, *Rec. Ind. Mus.*, XXII, p. 186.

The species occurs in great abundance in the lake and in various small muddy and rocky streams in the Myitkyina District.

A large series of *B. phutunio* was collected from different parts of the lake and from various streams in the Myitkyina District. The average length of the specimens is about 30 mm.

Barbus sophore (Ham. Buch.).

1822. *Cyprinus sophore*, Hamilton Buchanan, *Fish. Ganges*, pp. 310, 389, pl. xix, fig. 86.
 1839. *Cyprinus sophore*, McClelland, *Asiat. Research.*, XIX (2), pp. 285, 382.
 1842. *Cyprinus sophore*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, XVI, p. 388.
 1844. *Leuciscus stigma*, *id.*, *ibid.*, XVII, p. 93, pl. cccclxxxix.
 1844. *Leuciscus Duvaucelii*, *id.*, *ibid.*, XVII, p. 95, pl. cccxcxi.
 1844. *Leuciscus sulphureus*, *id.*, *ibid.*, XVII, p. 96.
 1849. *Systomus sophore*, Jerdon, *Madr. Journ. Lit. Sc.*, XV, p. 316.
 1867. *Puntius modestus*, Kner, *Novara Fische.*, p. 348, pl. xv, fig. 3.
 1868. *Puntius stigma*, Day, *Proc. Zool. Soc. London*, p. 198.
 1868. *Barbus sophore*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 152.
 1869. *Barbus (Puntius) stigma*, Day, *Proc. Zool. Soc. London*, p. 375.
 1878. *Barbus stigma*, Day, *Fish. India*, p. 579, pl. cxli, fig. 5.
 1889. *Barbus stigma*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 329.
 1889. *Barbus stigma*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 300.
 1911. *Barbus stigma*, Chaudhuri, *Rec. Ind. Mus.*, VI, p. 15.
 1916. *Barbus sophore*, Chaudhuri, *Mem. Ind. Mus.*, V, p. 436.
 1916. *Barbus sophore*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 256.

The characteristic black caudal spot, as also the dark mark across the base of the middle of the dorsal fin, are present in all the specimens ; but the coloured lateral band is often absent. Barbels are absent.

Ten specimens of *B. sophore* were obtained from the shallower parts of the lake along the western shore, and one from a small muddy stream along the Kamaing Jade Mines Road at Kamaing in the Myitkyina District. The largest of these specimens is 39 mm. long.

Esomus¹ altus (Blyth).

1860. *Nuria alta*, Blyth, *Journ. Asiat. Soc. Bengal*, XXIX, p. 162.
 1868. *Nuria alta*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 201.
 1869. *Nuria alta*, Day, *Proc. Zool. Soc. London*, p. 558.
 1878. *Nuria danrica* var. *alta*, Day, *Fish. India*, p. 583, pl. cxlv, fig. 8.
 1885. *Nuria danrica*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) II, p. 301.
 1889. *Nuria danrica* var. *alta*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 334, fig. 106.
 1889. *Nuria danrica*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 301.
 1910. *Nuria danrica* var. *alta*, Jenkins, *Rec. Ind. Mus.*, V, p. 138.
 1923. *Esomus altus*, Ahl, *Mitt. Zool. Mus. Berlin*, XI, p. 39.
 1928. *Esomus altus*, Hora & Mukerji, *Rec. Ind. Mus.*, XXX, p. 42, figs. 1a, 1b, 1c.

In the recent revision of the genus *Esomus* by Hora and Mukerji this species was dealt with in detail. It is a strictly Burmese species and has so far been reported from Tenasserim, Rangoon, Moulmein, Pegu, Prome and Mandalay.

Two specimens of *E. altus* were collected from Chaungwa in the Myitkyina District ; their average length is 70 mm.

¹ Attention may be drawn here to Jordan (*Classification of Fishes*, III, (2), p. 144¹ 1923) who, on the authority of Nichols, considers *Pogonocharax* Regan (*Ann. Mag. Nat. Hist.*, (7) XIX, p. 261, 1907) to be only a synonym of *Esomus* Swainson.

Rasbora daniconius (Ham. Buch.).

1822. *Cyprinus daniconius* & *anjana*, Hamilton Buchanan, *Fish. Ganges*, pp. 327, 329, 391, pl. xv, fig. 89.
 1864. *Rasbora dandia*, Bleeker, *Cyp. & Cobit. Ceylon*, p. 18, pl. i, fig. 3.
 1868. *Rasbora daniconius*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 194.
 1878. *Rasbora daniconius*, Day, *Fish. India*, p. 584, pl. cxlvi, fig. 2.
 1889. *Rasbora daniconius*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 336.
 1910. *Rasbora daniconius*, Jenkins, *Rec. Ind. Mus.*, V, p. 138.
 1911. *Rasbora daniconius*, Chaudhuri, *Rec. Ind. Mus.*, VI, p. 18.
 1919. *Rasbora daniconius*, Annandale, *Rec. Ind. Mus.*, XVI, p. 125.
 1921. *Rasbora daniconius*, Hora, *Rec. Ind. Mus.*, XXII, p. 743.

The number of predorsal scales is variable. In specimens from the Indawgyi Lake and some parts of Assam and Burma there are 12 rows in front of the dorsal fin, while in individuals from other parts of the same areas there are 14 rows. We can, however, find no other differences to separate the two forms.

R. daniconius is common all over the lake and in the adjoining streams. A very large series was collected from different parts of the lake and from the various muddy and rocky streams and pools in the Myitkyina District. The average length of the specimens is 40 mm.

Rasbora rasbora (Ham. Buch.).

1822. *Cyprinus rasbora*, Hamilton Buchanan, *Fish. Ganges*, pp. 329, 391, pl. ii, fig. 9.
 1868. *Rasbora Buchananii*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 196.
 1878. *Rasbora Buchananii*, Day, *Fish. India*, p. 584, pl. cxlv, fig. 10.
 1889. *Rasbora buchanani*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 337, fig. 107.
 1913. *Rasbora rasbora*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 252.
 1916. *Rasbora rasbora*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 259.
 1921. *Rasbora rasbora*, Hora, *Rec. Ind. Mus.*, XXII, pp. 187, 744.
 1923. *Rasbora rasbora*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 152.

The caudal fin is distinctly tipped with black as is the case with all Burmese examples.

R. rasbora is more or less common in the lake, as also in the pools and streams roundabout, but it appears to be less common than *R. daniconius*.

Four specimens were obtained from the western area of the lake and three from the streams at Kamaing in the Myitkyina District. The largest specimen before us measures 80 mm. in length.

Rohtee alfrediana (Cuv. & Val.).

1844. *Leuciscus Duvaucelii*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, XVII, p. 77, (nec p. 95).
 1844. *Leuciscus Alfrediana*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, XVII, p. 78, pl. cccc lxxxviii.
 1860. *Osteobrama cotis*, Blyth, *Journ. Asiat. Soc. Bengal*, XXIX, p. 158.
 1868. *Osteobrama Alfrediana*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 324.
 1878. *Rohtee cotio* var. *Alfrediana* (in part), Day, *Fish. India*, p. 587, pl. cxlvii, fig. 2.
 1889. *Rohtee cotio* var. *alfrediana*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 341, fig. 109.
 1889. *Osteobrama Alfrediana*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 316.
 1921. *Rohtee alfrediana*, Hora, *Rec. Ind. Mus.*, XXII, p. 188.

There are 18—22 predorsal scales. The numbers of scales along the lateral line vary from 48 to 52, and there are $9\frac{1}{2}$ to $10\frac{1}{2}$ rows of scales between the lateral line and the base of the ventral. There are no barbels.

The spirit specimens of the species are bright silvery in colour, the portion above the lateral line being olivaceous. A silvery lateral band is present. A black crescentic band is usually present just behind the gill cover. A whitish rod-shaped mark on the occiput is characteristic of the species.

According to the field notes of Dr. Chopra *R. alfrediana* is "extremely abundant in the southern part of the lake and in the Nanyinhka¹ stream. It is considered as one of the best edible fish."

A large series of this species was collected from different areas of the lake; the largest specimen is 115 mm. long.

***Rohtee belangeri* (Cuv. & Val.).**

1844. *Leuciscus Belangeri*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, XVII, p. 99.

1868. *Smiliogaster Belangeri*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 328.

1878. *Rohtee Belangeri*, Day, *Fish. India*, p. 587, pl. cxlvii, fig. 4.

1889. *Rohtee belangeri*, Day, *Faun. Brit. Ind., Fish.* I, p. 342.

1889. *Osteobrama Belangeri*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 318.

1921. *Rohtee belangeri*, Hora, *Rec. Ind. Mus.*, XXII, p. 188, fig. 2a.

We have examined a large series of *R. belangeri* from Rangoon, Pegu, Promé and Mandalay in Burma, and a few specimens from Manipur in Assam, and find that Day's description is not accurate in all respects. We, therefore, give below a summary of our observations.

The length of the head is contained from 4 to $4\frac{1}{2}$ times and the depth of the body about $2\frac{1}{2}$ times in the length of the body without the caudal. The diameter of the eye $3\frac{1}{2}$ to $4\frac{1}{2}$ in the length of the head, 1 to $1\frac{1}{2}$ diameters from the tip of the snout and $1\frac{1}{2}$ to 2 diameters apart.

The dorsal fin is inserted just above the middle of the ventral and lies midway between the tip of the snout and the base of the caudal fin. The pectoral is as long as the length of the head up to the opening of the nostrils.

The scales are small and vary greatly in number and arrangement. There are about 65 to 78 scales along the lateral line, $14\frac{1}{2}$ to $20\frac{1}{2}$ between the lateral line and the base of the ventrals and 20 to 35 before the dorsal fin.

Hora (*op. cit.*) has rightly pointed out that the "species is distinguished from the rest included in the genus *Rohtee* by the fact that the whole of the abdominal edge is sharp whereas in others it is sharp behind the ventrals but flat and rounded in front of them."

In the spirit specimens the back is dark greyish, while the belly is silvery glossed with gold. A black band from the shoulder to the base of the pectoral fin is generally present. The scales have dark spots at their free margins. The orbit is orange-coloured.

In the Indawgyi Lake *R. belangeri* is not so common as *R. alfrediana* and *R. feae*; only a single specimen 240 mm. in length was obtained from the western part of the lake.

¹ Nanyinhka is a fairly big stream that feeds the south end of the lake.

Rohtee feae (Vincig.).

1889. *Osteobrama Feae*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 311, pl. x, fig. 10.

1921. *Rohtee feae*, Hora, *Rec. Ind. Mus.*, XXII, p. 189, fig. 2b.

The specimens before us agree in all details with Vinciguerra's description except that there are 12 rays, 4 osseous and 8 branched, in the dorsal fin, and not 11 as mentioned by Vinciguerra.

In the Indawgyi lake *R. feae* is not so common as *R. alfrediana*. In certain parts of the lake, specially in the south-western area, the fishermen do not differentiate between the two species and they are known as *Nga-hpa-ma*. The fishermen of Chaungwa (a large fishing village at the junction of the Indaw and the Nam Ting rivers), however, distinguish *R. feae* from *R. alfrediana* and call them *Nga-hpa-ma* and *Nga-salam-bya* respectively.

Three specimens of this species were procured, two from the lake and one from Namkawng *chaung* at Kamaing in the Myitkyina District. The specimen from Kamaing is 165 mm. long.

Distribution.—*R. feae* has so far been recorded from Mandalay, Bhamo and Tabung, in Burma.

Barilius guttatus Day.

1869. *Opsarius guttatus*, Day, *Proc. Zool. Soc. London*, p. 620.

1878. *Barilius guttatus*, Day, *Fish. India*, p. 593, pl. cxlix, fig. 3.

1889. *Barilius guttatus*, Day, *Faun. Brit. Ind.*, *Fish. I*, p. 351.

1889. *Barilius guttatus*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 310.

The interorbital width is slightly smaller than the length of the snout which is about $1\frac{1}{2}$ times the diameter of the eye. There are no barbels. The pectoral fin is nearly as long as the head without the snout.

No specimens of *B. guttatus* were found in the lake. The only two specimens in the collection were obtained from the Kamaing fish market. The larger of the two examples is 162 mm. in length.

Danio aequipinnatus (McClell.).

1839. *Perilampus aequipinnatus*, McClelland, *Asiat. Research.*, XIX (2), p. 393, pl. lx, fig. 1.

1853. *Leuciscus aequipinnatus*, Bleeker, *Verh. Bat. Gen.*, XXV, p. 66.

1858. *Leuciscus lineolatus*, Blyth, *Journ. Asiat. Soc. Bengal*, XXVII, p. 219.

1868. *Danio lineolatus*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 282.

1878. *Danio aequipinnatus*, Day, *Fish. India*, p. 596, pl. cl, fig. 5.

1889. *Danio aequipinnatus*, Day, *Faun. Brit. Ind.*, *Fish. I*, p. 356, fig. 111.

1889. *Danio aequipinnatus*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 304.

1913. *Danio aequipinnatus*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 252.

1918. *Danio aequipinnatus*, Annandale, *Rec. Ind. Mus.*, XIV, pp. 35, 68, 211.

1919. *Danio aequipinnatus*, Chaudhuri, *Rec. Ind. Mus.*, XVI, p. 283.

1921. *Danio aequipinnatus*, Hora, *Rec. Ind. Mus.*, XXII, p. 193.

1923. *Danio aequipinnatus*, Hora, *Rec. Ind. Mus.*, XXV, p. 582.

1923. *Danio aequipinnatus*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 153.

1924. *Danio aequipinnatus*, Hora, *Rec. Ind. Mus.*, XXVI, p. 28.

1924. *Danio aequipinnatus*, Myers, *Amer. Mus. Novit. New York* (150), p. 3.

In colour the specimens agree in all details with that of the specimens described by Hora from various streams in Manipur, Assam.

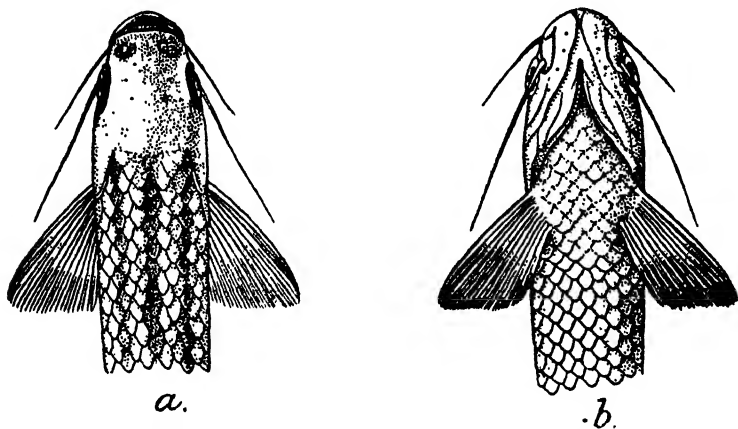
Only two specimens of *D. aequipinnatus* were obtained, one from a rocky stream about half a mile from Namma Rest House, and the other from Sattan *chaung* inside and near the Paudawmu cave about 8 miles from Kamaing, in the Myitkyina District. They are about 50 mm. long.

Danio (Brachydanio) rerio (Ham. Buch.).

(Plate VII, fig. 5).

1822. *Cyprinus rerio*, Hamilton Buchanan, *Fish. Ganges*, pp. 323, 390.
 1839. *Perilampus striatus*, McClelland, *Asiat. Research.*, XIX (2), pp. 290, 397, pl. xxxvii, fig. 1 (from H. B.'s Mss.).
 1868. *Barilius rerio*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 292.
 1868-1869. *Danio lineatus*, Day, *Proc. Zool. Soc. London*, pp. 198, 378.
 1878. *Danio rerio*, Day, *Fish. India*, p. 597, pl. cli, fig. 4.
 1889. *Danio rerio*, Day, *Faun. Brit. Ind., Fish.* I, p. 358.
 1921. *Danio rerio*, Hora, *Rec. Ind. Mus.*, XXII, p. 743.

In 1822 Hamilton Buchanan described the species as *Cyprinus rerio* which he had originally found in the Kosi River on the northern boundary of Bengal. In his manuscript drawings of fishes there is a finished figure numbered 144 and labelled *Cyprinus kirki jongja*. Unfortunately the figure is partly damaged, the head portion having been eaten away by insects. Although damaged and inaccurate in some respects, it shows the beautiful bright colouration which is a striking feature of *D. rerio*. No figure of the species was included in the plates which were published with the same author's *Fishes of the Ganges*, but the figure of *C. kirki jongja* was reproduced by McClelland. Day's figure of *D. rerio* is poor and does not show any detail.



TEXT-FIG. 8.—*Danio (Brachydanio) rerio* (Ham. Buch.) from Myitkyina District.

- (a) Dorsal view of anterior portion of body, $\times 2$.
 (b) Ventral view of anterior portion of body, $\times 2$.

The specimens under report differ from normal specimens of *D. rerio* in having a distinct lateral line extending in some cases to the base of the ventral, greater number of predorsal scales and smaller number of coloured bands on the caudal fin. These characters, however, do not justify the erection of a new species, but for the purpose of reference we give below a complete description and publish a figure of a Burmese

The lateral line has been described as "scarcely observable" (Hamilton Buchanan) or "absent" (Day) in *D. rerio*. We have carefully examined a large series of specimens of the species from different localities in the collections of the Indian Museum and find that the lateral line in this species is very variable. In the following table we give the results of our examination from which it is clear that the lateral line in specimens from different localities may be present, rudimentary or absent.

| Registered number. | Locality. | Donor. | Number of specimens examined. | Lateral line present. | Lateral line rudimentary. | Lateral line absent. |
|--------------------|-----------------|------------------------|-------------------------------|---------------------------|---------------------------|----------------------|
| Cat. 872 .. | ? | Asiat. Soc. of Bengal. | 11 | 2-6 scales in 4. | 2 | 5 |
| 2482 .. | Orissa .. | F. Day .. | 1 | .. | .. | 1 |
| F.1882/1 .. | Bhura, U. P. | Mus. Coll. | Many | 1-2 scales in most cases. | In some .. | In few. |
| F.1883/1 .. | Amanghar, U. P. | Do. .. | Do. | Do. .. | Do. .. | Do. |
| F.4948/1 .. | Naini Tal Dist. | Do. .. | Do. | Do. .. | Do. .. | Do. |
| F.4950/1 .. | Do. .. | Do. | 1 | .. | .. | 1 |
| F.4953-62/1 | U. P. . | Do. .. | 10 | 2-3 scales in most cases. | In some. | .. |
| F.7143-49/1 | Darrang .. | S. W. Kemp | 7 | 2-6 scales in 6. | .. | 1 |
| F.8571-72/1 | Orissa .. | N. Annandale. | 2 | .. | .. | 2 |
| F.9353/1 .. | Cooch Behar | T. Southwell. | Many | 2-4 scales in most cases. | .. | In some. |

D. 2/7, A. 3/12-14, P. 1/12, V. 8, C. 20-22, L. 1. 28-30, L. tr. 6.

The dorsal profile rises gradually from the tip of the snout to the commencement of the dorsal fin beyond which it gradually slopes down to a level almost parallel to the ventral margin of the caudal peduncle. The ventral profile is considerably arched to the base of the anal fin.

The length of the head is contained from 3.7 to 4.1 times and the depth of the body from 3.6 to 3.7 times in the total length of the body excluding the caudal. The diameter of the eye is contained from 3.1 to 3.4 times in the length of the head. The snout is shorter than the diameter of the eye and is contained from 1.5 to 1.7 times in the inter-orbital width.

The dorsal fin is inserted slightly in advance of the anal; its longest ray is as long as the head without the snout. The pectorals are generally as long as the head, including the snout. They scarcely reach the ventrals which are usually separated from the anal by a short distance. In younger specimens, however, the pectorals very nearly reach the ventrals and the ventrals extend to the anal. The caudal fin is moderately emarginate and is as long as the pectoral. The paired fins are provided with small scaly appendants.

The scales are medium-sized, thin and shining. The lateral line is incomplete and, as noted above, extends in some cases to the base of the ventrals. There are two pairs of barbels. The maxillary barbels are

variable in length and may extend up to as far as the middle of the pectorals. The rostral barbels are considerably shorter and nearly twice as long as the diameter of the eye.

The ground colour of the body is dark yellow, darker above and lighter below. Four dark bluish longitudinal parallel bands run along the sides alternating with silvery ones. The lowermost coloured band is, in some cases, narrow, and does not extend beyond the anal fin. In many cases the coloured bands are wavy, in others they break up irregularly into small rods or dots. All the fins are diaphanous. Usually there is a narrow bluish band across the dorsal fin; two or three such bands are also present in the anal and three or more in the caudal.

D. (Brachydanio) rerio is common in the muddy and rocky streams roundabout Kamaing, in the Myitkyina District. It was found also in the Sattan *chaung* inside and near the Paudawmu cave about 8 miles from Kamaing.

A large series of this species was collected from different streams in the Myitkyina District.

Measurements in millimetres.

| | | | |
|---------------------------------------|------|------|------|
| Total length without caudal | 32.0 | 29.0 | 29.0 |
| Length of head | 8.5 | 7.0 | 7.0 |
| Height of body | 8.5 | 8.0 | 8.0 |
| Length of snout | 2.0 | 2.0 | 2.0 |
| Diameter of eye | 2.5 | 2.25 | 2.25 |
| Interorbital width | 3.5 | 3.0 | 3.0 |
| Length of caudal peduncle | 5.0 | 5.0 | 5.0 |
| Least height of caudal peduncle | 4.0 | 3.5 | 3.25 |
| Length of pectoral fin | 8.5 | 7.5 | 7.5 |
| Length of ventral fin | 5.0 | 4.5 | 4.5 |

***Danio (Brachydanio) choprae* Hora.**

1928. *Danio (Brachydanio) choprae*, Hora, *Rec. Ind. Mus.*, XXX, p. 39, fig. 2.

This species was collected at the same time as the rest of the collection under report, and was described as a new form by Dr. S. L. Hora in the paper cited above.

D. (Brachydanio) choprae is a small species never exceeding 30 mm. in length and does not occur in the Indawgyi Lake. Several specimens were collected from various small rocky streams roundabout Kamaing and Namma, in the Myitkyina District.

***Laubuca (Laubuca) laubuca* (Ham. Buch.).**

1822. *Cyprinus laubuca*, Hamilton Buchanan, *Fish. Ganges*, p. 260.

1839. *Perilampus guttatus*, McClelland, *Asiat. Research.*, XIX (2), p. 394.

1868. *Chela laubuca*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 335.

1878. *Perilampus laubuca*, Day, *Fish. India*, p. 598.

1889. *Perilampus laubuca*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 360, fig. 112.

1916. *Laubuca (Laubuca) laubuca*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, III, p. 48.

There is no black blotch at the base of the caudal fin. The dorsal, the anal and the caudal fins are tipped with black. The filiform outer rays of the ventrals do not reach the anal, nor do the falcate pectorals extend to the anus.

L. (Laubuca) laubuca is not very common in the lake ; only two specimens were collected from the northern part of the lake. The specimens vary from 45-55 mm. in length.

***Chela sladeni* Day.**

1869. *Chela sladeni*, Day, *Proc. Zool. Soc. London*, p. 622.
 1878. *Chela sladeni*, Day, *Fish. India*, p. 600, pl. clii, fig. 3.
 1889. *Chela sladeni*, Day, *Faun. Brit. Ind., Fish. I*, p. 363, fig. 113.
 1889. *Chela sladeni*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 319.

We adopt, with Vinciguerra, the correct specific name *sladeni* in preference to *sladoni* as it was spelt by Day.

C. sladeni was not found in the lake, and only one specimen of it measuring 106 mm. in length was taken at Kamaing, in the Myitkyina District.

Family CLUPEIDAE.

***Gudusia variegata* (Day).**

1869. *Clupea variegata*, Day, *Proc. Zool. Soc. London*, p. 263.
 1878. *Clupea variegata*, Day, *Fish. India*, p. 639, pl. clxi, fig. 4.
 1889. *Clupea variegata*, Day, *Faun. Brit. Ind., Fish. I*, p. 375.
 1889. *Clupea variegata*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 354.
 1907. *Clupea variegata*, Lloyd, *Rec. Ind. Mus.*, I, p. 221.
 1910. *Clupea variegata*, Jenkins, *Rec. Ind. Mus.*, V, p. 138.
 1917. *Gudusia variegata*, Regan, *Ann. Mag. Nat. Hist.* (8) XIX, p. 308.
 1924. *Gudusia variegata*, Myers, *Amer. Mus. Novit. New York* (150), p. 1.

There are 14 to 18 ventral spines in front of the pelvic fin and 10 to 11 spines behind it.

G. variegata is fairly common in the rivers and streams connected with the Indawgyi Lake.

In the collection before us there are two specimens from the Namsanda stream in the northern end of the lake and one from Namkawng *chaung* at Kamaing, in the Myitkyina District. The largest of the three specimens is 170 mm. long.

Family NOTOPTERIDAE.

***Notopterus notopterus* (Pallas).**

1769. *Gymnotus notopterus*, Pallas, *Spicil. Zool.* VII, p. 40.
 1800. *Notopterus kapirat*, Lacépède, *Hist. Nat. Poisson*, II, p. 190.
 1868. *Notopterus kapirat*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 480.
 1866-1872. *Notopterus kapirat*, Bleeker, *Atl. Ichth.*, VI, p. 146.
 1878. *Notopterus kapirat*, Day, *Fish. India*, p. 653, pl. clix, fig. 4.
 1889. *Notopterus kapirat*, Day, *Faun. Brit. Ind., Fish. I*, p. 406, fig. 129.
 1889. *Notopterus kapirat*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 355.
 1913. *Notopterus notopterus*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, II, p. 9.
 1918. *Notopterus notopterus*, Annandale, *Rec. Ind. Mus.*, XIV, p. 53.
 1923. *Notopterus notopterus*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 175.

The length of the head without the opercular flap is less than $\frac{1}{2}$ the length of the body. The pectoral fins are as long as the length of the head behind the middle of the eye,

N. notopterus is a common fish in the Indawgyi Lake, specially in its south-western area. It is said to live generally in the deeper parts, but "during floods and high water it hides itself in reeds and grass in shallow water." In the lake it grows to a weight of about 2 lbs.

Five specimens were collected from the south-western part of the lake and one from Kamaing, in the Myitkyina District. The largest one from the lake is 270 mm. long.

Family BELONIDAE.

Xenentodon cancila (Ham. Buch.).

1822. *Esox cancila*, Hamilton Buchanan, *Fish. Ganges*, pp. 214, 380, pl. xxvii, fig. 70.
 1841. *Belone Graii*, Sykes, *Trans. Zool. Soc. London*, II, p. 367, pl. lxiii, fig. 4.
 1846. *Belone cancila*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, XVIII, p. 455.
 1866. *Belone cancila*, Günther, *Cat. Fish. Brit. Mus.*, VI, p. 253.
 1878. *Belone cancila*, Day, *Fish. India*, p. 511, pl. cxviii, fig. 5.
 1889. *Belone cancila*, Day, *Faun. Brit. Ind. Fish. I*, p. 420, fig. 136.
 1889. *Belone cancila*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 349.
 1913. *Belone cancila*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 256.
 1922. *Xenentodon cancila*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, IV, p. 134.
 1923. *Xenentodon cancila*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 175.

In some specimens there are three dark blotches along the sides between the pectorals and the anal fin.

X. cancila was not found in the lake, but it is fairly common in the Namsanda stream in the north end of the lake.

Six specimens were collected from the Namsanda stream and one from Chaungwa, in the Myitkyina District.

Family PERCIDAE.

Ambassis ranga (Ham. Buch.).

1822. *Chanda ranga*, Hamilton Buchanan, *Fish. Ganges*, pp. 113, 371, pl. xvi, fig. 38.
 1822. *Chanda lala*, Hamilton Buchanan, *Fish. Ganges*, pp. 114, 371, pl. xxix, fig. 39.
 1828. *Ambassis alta*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, II, p. 183.
 1859. *Ambassis alta*, Günther, *Cat. Fish. Brit. Mus.*, I, p. 227.
 1875. *Ambassis ranga*, Day, *Fish. India*, p. 51, pl. xiv, fig. 6.
 1889. *Ambassis ranga*, Day, *Faun. Brit. Ind., Fish. I*, p. 485.
 1910. *Ambassis ranga*, Jenkins, *Rec. Ind. Mus.*, V, p. 138.
 1913. *Ambassis ranga*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 256.
 1916. *Ambassis ranga*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 278.
 1921. *Ambassis ranga*, Hora, *Rec. Ind. Mus.*, XXII, p. 204.

The vertical border of the preoperculum is closely serrated and serrations are also present on the lower margin of its horizontal border. The upper margin of the horizontal border is provided with only a few serrations at the free angle.

The colour of the specimens in spirit is yellowish-orange, mottled with minute dark brown dots all over. A blackish shoulder spot is present in some specimens. In some cases there are 5 to 6 narrow slightly curved blackish vertical bands in the middle of the body. These bands, as was observed by Hora, are less distinct or entirely absent in young individuals. The caudal fin is slightly tipped with black.

A. ranga is very common in the Indawgyi Lake and in various small rocky streams in this part of the country, and is represented in the collection by a large number of specimens ; the average length of the specimens is 65 mm.

Ambassis baculis (Ham. Buch.).

1822. *Chanda baculis*, Hamilton Buchanan, *Fish. Ganges*, pp. 112, 371.
 1828. *Ambassis baculis*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, II, p. 187.
 1875. *Ambassis baculis*, Day, *Fish. India*, p. 51, pl. xv, fig. 1.
 1889. *Ambassis baculis*, Day, *Faun. Brit. Ind.*, *Fish.* I, p. 485.
 1910. *Ambassis baculis*, Jenkins, *Rec. Ind. Mus.*, V, p. 138.

The vertical limb of the preoperculum is entire ; the whole of the lower limb and the ridge above it are strongly serrated.

Day is not consistent in his accounts of *A. baculis* and *A. nama*. In the descriptions of *A. nama* and *A. baculis* he states that " the vertical limb of preopercle is entire," while in the distinguishing characters between the two species he observes that "*A. baculis* principally differs from *A. nama* in its form being higher, its lower jaw shorter and not crooked to one side, its vertical limb of preopercle being strongly serrated and its possessing no canine or enlarged teeth in its jaws." We have examined a specimen of *A. nama* which was figured by Day in the " Fishes of India " and some of Day's specimens of *A. baculis*, and find that the vertical limb of the preoperculum is entire in both the species. Fairly enlarged teeth also are present in Day's specimens of *A. baculis* from the N. W. Provinces as well as in the specimens under report.

A. baculis is more or less common in the lake and different streams, but less so than *A. ranga*.

Five specimens were collected from the south-western area of the lake and one from a sluggish stream in the vicinity. The average length of the specimens is 75 mm.

Family NANDIDAE.

Badis badis (Ham. Buch.).

1822. *Labrus badis*, Hamilton Buchanan, *Fish. Ganges*, pp. 70, 368, pl. xxv, fig. 23.
 1853. *Badis Buchananii*, Bleeker, *Verh. Bat. Gen.*, XXV, p. 106, pl. ii, fig. 3.
 1861. *Badis Buchananii*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 367.
 1875. *Badis Buchananii*, Day, *Fish. India*, p. 128, pl. xxxi, fig. 6.
 1889. *Badis Buchananii*, Day, *Faun. Brit. Ind.*, *Fish.* II, p. 80, fig. 38.
 1889. *Badis buehanani*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 166.
 1912. *Badis badis*, Sewell & Chaudhuri, *Ind. Fish of Prov. Util. etc.*, p. 12, fig. c.
 1913. *Badis badis*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 256.
 1919. *Badis badis*, Chaudhuri, *Rec. Ind. Mus.*, XVI, p. 286.
 1921. *Badis badis*, Hora, *Rec. Ind. Mus.*, XXII, p. 204.

In colouration these specimens very nearly agree with Day's description excepting that the vertical bands are 8 or 9 instead of 6. The colour pattern in general is very vivid in young individuals, but becomes more or less dull as they grow in size.

B. badis is quite common in the various muddy and rocky streams and pools in the Myitkyina District.

A large series of specimens was collected from various muddy and rocky streams. The average length is 35 mm.

***Badis dario* (Ham. Buch.).**

(Plate VII, figs. 6, 7, 7a.)

1822. *Labrus dario*, Hamilton Buchanan, *Fish. Ganges*, pp. 72, 368.

1861. *Badis dario*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 367.

1875. *Badis dario*, Day, *Fish. India*, p. 129.

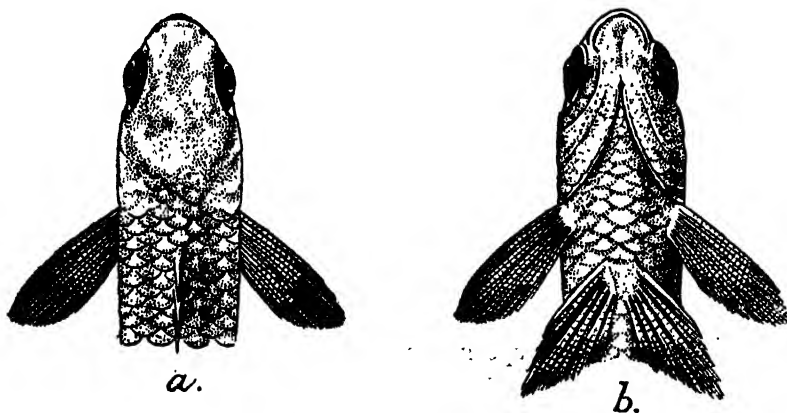
1889. *Badis dario*, Day, *Faun. Brit. Ind., Fish.* II, p. 82.

As the specimens from Upper Burma, which we refer to *B. dario*, differ in several respects from the published descriptions of the species, we give below a detailed description of our specimens.

D. 15/5-7, A. 3/7-8, P. 10-12, V. 1/5, C. 18, L. 1. 26-28, L. tr. 8.

The length of the head is almost equal to the depth of the body and is contained from 3 to 3.4 times in the total length of the body without the caudal. The diameter of the eye is contained from 3 to 3.6 times in the length of the head and is slightly longer than the interorbital width. The snout is shorter than the diameter of the eye and is almost equal to the interorbital width. The convexity of the dorsal profile, as also the depth of the body, are less than those of *B. badis* (Ham. Buch.).

The dorsal fin commences just above the ventrals. The soft part is slightly higher and posteriorly ends in a sharp acute angle. The pectorals are short and spatulate. The ventrals do not reach the anal which is inserted slightly behind the middle of the dorsal fin. Like the dorsal the anal fin also ends in a sharp angle posteriorly. The last anal spine is the longest. The caudal fin is wedge-shaped. All the fin rays are branched distally. Both the dorsal and the anal fins are scaly at their bases. The scales are of moderate size.



TEXT-FIG. 9.—*Badis dario* (Ham. Buch.) from Myitkyina District.

(a) Dorsal view of anterior portion of body, $\times 5$.

(b) Ventral view of anterior portion of body, $\times 5$.

The ground colour of the specimens in spirit is dirty whitish with minute pinkish dots uniformly distributed ; slightly bigger spots are found along the margins of the scales. In some specimens there are 7 or 8 faint pinkish vertical bands along the sides of the body. All the fins, with the exception of the pectorals which are more or less diaphanous, are dusky.

In the manuscript drawings of Hamilton Buchanan there is a finished figure and an outline drawing, numbered 93 and labelled *Labrus darhi*. This is undoubtedly the figure of the species which Hamilton Buchanan in 1822 described as *Labrus dario*. Of the other species, *Labrus badis*, he published a figure in the plates of his *Fishes of the Ganges* (pl. xxv, fig. 23). This published figure is quite distinct from the manuscript drawing referred to above and Day (*Proc. Asia! Soc. Bengal*, p. 205, Sept. 1871) is certainly wrong in considering the two as belonging to the same species. The differences lie in the form of the fish, the form of the fins, the form of the head and eyes, as also the position of the mouth and the operculum. Further, the presence of the lateral line in the published figure clearly shows that it is quite distinct from *Labrus darhi* (= *Labrus dario*) in which the lateral line is entirely absent.

The unpublished figures which we reproduce (pl. vii, figs. 7, 7a) are undoubtedly of the fish under consideration and which is now known as *Badis dario* (H. B.). Hamilton Buchanan's is the only figure of the species which we can find and we, therefore, reproduce enlarged figures of this fish showing details of the lepidosis, as also the form of the fins and the number of the fin rays in each.

We are indebted to Dr. S. I. Hora for the information that "*Darhi*" as the common name of the species is mentioned in Hamilton Buchanan's manuscript notes, which are preserved in the library of the India Office, London.

Like *B. badis*, *B. dario* is quite common in various muddy and rocky streams in the Myitkyina District.

A large series of this species was collected from different muddy and rocky streams in the district. It appears to be a smaller species than *B. badis*, none exceeding 20 mm. in length. Day's statement about *B. dario* growing to a maximum length of "three inches" requires confirmation.

Family MASTACEMBELIDAE.

Mastacembelus armatus (Lacép.).

- 1800. *Macrogathus armatus*, Lacépède, *Hist. Nat. Poisson*, II, p. 286.
- 1861. *Mastacembelus armatus*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 542.
- 1876. *Mastacembelus armatus*, Day, *Fish. India*, p. 340, pl. lxxiii, fig. 2.
- 1889. *Mastacembelus armatus*, Day, *Faun. Brit. Ind., Fish.* II, p. 334.
- 1889. *Mastacembelus armatus*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 180.
- 1910. *Mastacembelus armatus*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 290.
- 1919. *Mastacembelus armatus*, Annandale, *Rec. Ind. Mus.*, XVI, p. 125.

This species is widely distributed in the Indawgyi Lake along the shores and shallower parts and lives in mud near the shore and in the hollows of floating logs of trees. It is said to grow to about 4 lbs.

Four specimens were collected from different parts of the lake and another specimen, 560 mm. long, from Chaungwa, in the Myitkyina District.

Family CHAUDHURIIDAE.

Chaudhuria caudata Annandale.

1918. *Chaudhuria caudata*, Annandale, *Rec. Ind. Mus.*, XIV, pp. 39-42, pl. i, fig. 1; pl. iv, figs. 1-10.
 1918. *Chaudhuria caudata*, Whitehouse, *Rec. Ind. Mus.*, XIV, p. 65.
 1919. *Chaudhuria caudata*, Regan, *Ann. Mag. Nat. Hist.* (9) III, p. 198.
 1923. *Chaudhuria caudata*, Annandale & Hora, *Ann. Mag. Hist. Nat.* (9) XI, pp. 327-333.

The single specimen measuring 31 mm. in length, which we provisionally refer to this species, was collected from Namkawng stream at Kamaing in the Myitkyina District. This specimen differs from the Inlé Lake specimens in that the eyes are comparatively dorsally placed and the interorbital width is consequently narrower. This slight difference in the position of the eyes may be the result of pressure due to preservation. This appears very probable, as the bones of the skull of this fish are extremely delicate and the jaws are very feeble.

On the sides there is a series of open Vs of a dark purplish-brown colour with their apices directed anteriorly.

Family OPHIOCEPHALIDAE.

Ophiocephalus marulius Ham. Buch.

1822. *Ophiocephalus marulius*, Hamilton Buchanan, *Fish. Ganges*, pp. 65, 367, pl. xvii, fig. 19.
 1861. *Ophiocephalus marulius*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 478.
 1876. *Ophiocephalus marulius*, Day, *Fish. India*, p. 363, pl. lxxvi, fig. 4.
 1889. *Ophiocephalus marulius*, Day, *Faun. Brit. Ind., Fish.* II, p. 360.
 1889. *Ophiocephalus marulius*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 182.

The usual large deep black ocellus encircled by a whitish ring at the upper part of the base of the caudal fin and five lateral black patches below the lateral line are present. The lateral marks are somewhat elongated in the younger individuals.

O. marulius is more or less common in the lake and is believed to live in areas with a muddy bottom. It is known to grow to a weight of about 15 lbs.

Four specimens were collected from the lake and one from Chaungwa. The largest specimen from the lake is 300 mm. long.

Ophiocephalus striatus Bloch.

1793. *Ophiocephalus striatus*, Bloch, *Nat. Ausl. Fische*, VII, p. 141, pl. oclix.
 1822. *Ophiocephalus wrahl*, Hamilton Buchanan, *Fish. Ganges*, p. 60.
 1831. *Ophiocephalus striatus*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, VII, p. 417.
 1861. *Ophiocephalus striatus*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 474.
 1876. *Ophiocephalus striatus*, Day, *Fish. India*, p. 366.

1889. *Ophiocephalus striatus*, Day, *Faun. Brit. Ind., Fish.* II, p. 363.
 1889. *Ophiocephalus striatus*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 184.
 1916. *Ophiocephalus striatus*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 270.
 1918. *Ophiocephalus striatus*, Annandale, *Rec. Ind. Mus.*, XIV, p. 54.
 1922. *Ophiocephalus striatus*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.* IV, p. 317.
 1923. *Ophiocephalus striatus*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 180.

The species is fairly common in the lake, and two specimens of it were collected from different areas, while two were also obtained at Chaungwa. The largest individual before us is 175 mm. long.

***Ophiocephalus gachua* Ham. Buch.**

1822. *Ophiocephalus gachua*, Hamilton Buchanan, *Fish. Ganges*, pp. 68, 367, pl. xxi, fig. 21.
 1831. *Ophiocephalus marginatus*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, VII, p. 411.
 1861. *Ophiocephalus gachua*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 471.
 1876. *Ophiocephalus gachua*, Day, *Fish. India*, p. 367.
 1889. *Ophiocephalus gachua*, Day, *Faun. Brit. Ind., Fish.* II, p. 364.
 1889. *Ophiocephalus gachua*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 185.
 1916. *Ophiocephalus gachua*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 275.
 1918. *Ophiocephalus gachua*, Annandale, *Rec. Ind. Mus.*, XIV, p. 35.
 1919. *Ophiocephalus gachua*, Annandale, *Rec. Ind. Mus.*, XVI, p. 137.
 1921. *Ophiocephalus gachua*, Hora, *Rec. Ind. Mus.*, XXII, p. 743.
 1922. *Ophiocephalus gachua*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.* IV, p. 321.
 1923. *Ophiocephalus gachua*, Hora, *Rec. Ind. Mus.*, XXVI, p. 31.
 1923. *Ophiocephalus gachua*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 181.

The species is very common in the Indawgyi Lake and the various streams in the Myitkyina District.

Quite a large number of specimens were collected, and the largest one in the collection, taken at Chaungwa, is 200 mm. long.

***Ophiocephalus punctatus* Bloch.**

1793. *Ophiocephalus punctatus*, Bloch, *Nat. Ausl. Fische*, VII, pl. ccolviii.
 1822. *Ophiocephalus lata*, Hamilton Buchanan, *Fish. Ganges*, pp. 63, 637, pl. xxxiv, fig. 18.
 1861. *Ophiocephalus punctatus*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 469.
 1876. *Ophiocephalus punctatus*, Day, *Fish. India*, p. 367, pl. lxxviii, fig. 1 (var.).
 1889. *Ophiocephalus punctatus*, Day, *Faun. Brit. Ind., Fish.* II, p. 364.
 1889. *Ophiocephalus punctatus*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 186.
 1916. *Ophiocephalus punctatus*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 273.
 1921. *Ophiocephalus punctatus*, Hora, *Rec. Ind. Mus.*, XXII, p. 207.

The back is deep brown, while the sides are yellowish, and there are also many irregular lateral patches of a black colour on the back. There is a very narrow yellowish stripe along the sides. Above the stripe there are about 10 to 12 blackish blotches. All the fins are mottled with black. The lateral line is interrupted before the 18th or 19th scale, but is continued again one scale below.

O. punctatus is fairly common in the lake and the pools. Two specimens were collected from the western parts of the lake and one from a pool near-by. The specimens are not full grown; the largest one being 102 mm. long.

Family ANABANTIDAE.

Anabas testudineus (Bloch).

1792. *Anthias testudineus*, Bloch, *Nat. Ausl. Fische*, VI, pl. cxxi.
 1797. *Perca scandens*, Daldroff, *Trans. Linn. Soc.*, III, p. 62.
 1822. *Cojus cobojus*, Hamilton Buchanan, *Fish. Ganges*, pp. 98, 370.
 1831. *Anabas scandens*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, VII, p. 249.
 1861. *Anabas scandens*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 375.
 1877. *Anabas scandens*, Day, *Fish. India*, p. 370, pl. lxxvii, fig. 3.
 1889. *Anabas scandens*, Day, *Faun. Brit. Ind., Fish.* II, p. 367, fig. 120.
 1916. *Anabas scandens*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 276.
 1922. *Anabas testudineus*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, IV, p. 334.
 1923. *Anabas testudineus*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI (2), p. 181.

A large black caudal spot and a smaller one at the hind border of the operculum are present. The colour of the specimens in spirit is uniformly dusky; the belly being pale yellowish.

A. testudineus is not so common in the lake itself, as it is in ponds, ditches, pools and streams in the Myitkyina District.

Three specimens of the species were collected from the south-western area of the lake and several others from various ponds and pools, etc. The largest individual is 80 mm. long.

Trichogaster fasciatus Bl. Schn.

1801. *Trichogaster fasciatus*, Bloch-Scheinder, *Syst. Ichth.*, p. 164.
 1822. *Trichopodus colisa*, Hamilton Buchanan, *Fish. Ganges*, pp. 117, 372.
 1861. *Trichogaster fasciatus*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 387.
 1877. *Trichogaster fasciatus*, Day, *Fish. India*, p. 374, pl. lxxviii, fig. 6.
 1889. *Trichogaster fasciatus*, Day, *Faun. Brit. Ind., Fish.* II, p. 372, fig. 123.
 1889. *Trichogaster fasciatus*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 187.
 1912. *Trichogaster fasciatus*, Sewell & Chaudhuri, *Ind. Fish. of Prov. Util. etc.*, p. 10, fig. 5.
 1922. *Trichogaster fasciatus*, Weber & Beaufort, *Fishes, Indo-Austral. Archipel.*, IV, p. 341.

There is generally a vertical bar at the base of the caudal fin.

T. fasciatus is quite common in the southern and western ends of the lake, from where a large series were collected. Two specimens were also obtained from a small muddy stream along the Kamaing Jade Mines Road at Kamaing, in the Myitkyina District. None of the individuals exceed 60 mm. in length.

Parasphaerichthys, gen. nov.

This new genus, for which we propose the name *Parasphaerichthys*, is represented in the collection by two specimens. They are small, about 23 mm. long, compressed and more or less oblong in shape. The mouth is greatly protactile, its cleft oblique and very small. The jaws are unequal, the lower one being considerably longer than the upper. The lateral line is entirely absent. The preorbital and the horizontal limb of the preoperculum are finely serrated. The eyes are very large. The dorsal fin is composed of 4 spines and 6 rays. The anal has 13 spines and 12 rays. The ventrals originate slightly behind the pectorals.

In general appearance this fish appears to be very closely allied to *Sphaerichthys Canestrini*,¹ but differs in several important characters. The characters of the two genera are tabulated below :

| | |
|---|---|
| <i>Sphaerichthys Canestrini.</i> | <i>Parasphaerichthys</i> , gen. nov. |
| Jaws equal. | Jaws unequal. |
| Lateral line vestigial. | Lateral line absent. |
| Dorsal fin with 8-12 spines and 7-10 rays. | Dorsal fin with 4 spines and 6 rays. |
| Anal fin with 8-10 spines and 18-22 rays. | Anal fin with 13 spines and 12 rays. |
| Ventrals originate slightly before pectorals. | Ventrals originate slightly behind pectorals. |

Genotype.—*Parasphaerichthys ocellatus*, sp. nov. from small muddy streams along the Kamaing Jade Mines Road—a few miles from Kamaing in the Myitkyina District.

***Parasphaerichthys ocellatus*, sp. nov.**

(Plate VIII, figs. 4, 4a.)

D. 4/6, A. 13/12, P. 9, V. 1/5, C. 16, L. 1. 27-28, L. tr. 11.

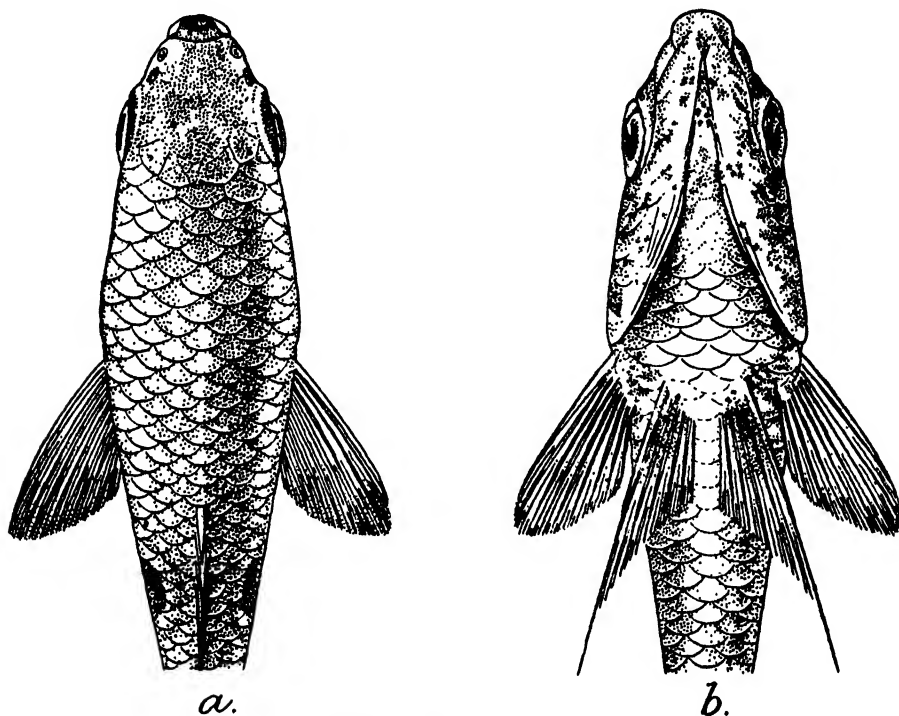
The length of the head is contained from 2·6 to 2·7 times and the depth of the body about 2·5 times in the total length of the body without the caudal. The eyes are situated in the anterior half of the head and their diameter is contained 3·4 times in the length of the former. The interorbital space is only slightly wider than the diameter of the eye. The length of the snout is shorter than the orbital width. The caudal peduncle is considerably higher than long.

The origin of the dorsal fin is just above or slightly behind the commencement of the anal and is nearer to the base of the caudal than to the tip of the snout. The last dorsal spine is the longest and is about as long as the head behind the middle of the eye. The pectoral is inserted in the lower half of the body ; its 1st, 8th and 9th rays are entire. The ventral spine is fairly long and the inner branch of the first ventral ray is produced into a long simple filament reaching as far as the middle of the anal. The anal originates almost below the pectoral ; it extends beyond the base of the caudal which latter is slightly rounded and is nearly as long as broad. Both the anal and the caudal fins are scaly at their bases.

The scales are large and arranged on the body in 27-28 scales in a longitudinal series and 11 in a transverse series. The opercular bones are all covered with scales and are entire, except for the horizontal limb of the preoperculum, which is finely serrated. Both the jaws are provided with fleshy lips and small conical teeth.

¹ Canestrini, J.—*Verh. Zool.-bot. Gesellsch. Wien*, X, p. 707 (1860).

The ground colour of the specimens in spirit is dusky. A dirty whitish fairly broad and indistinct lateral band runs along the entire length of



TEXT-FIG. 10.—*Parasphaerichthys ocellatus*, gen. et sp. nov.

- (a) Dorsal view of anterior portion of body of type-specimen, $\times 5$
 (b) Ventral view of anterior portion of body of the same, $\times 5$.

the body. There are small patches of white and black scattered here and there. The chin and the thorax are whitish. A very conspicuous deep black large ocellus bordered by white is present in the middle of the body. The fins are more or less diaphanous with fine black dots especially in the dorsal and anal fin membrane.

P. ocellatus was not found in the Indawgyi Lake or in the adjoining streams. The two specimens under report were collected from small muddy streams along the Kamaing Jade Mines Road, a few miles from Kamaing in the Myitkyina District.

Type-specimen.—No. F. 11011/1 in the collection of the Zoological Survey of India (*Ind. Mus.*), Calcutta.

Measurements in millimetres.

| | | | | |
|---------------------------------|----|----|------|------|
| Total length without caudal | .. | .. | 23.0 | 22.5 |
| Length of head .. | .. | .. | 8.5 | 8.5 |
| Height of body .. | .. | .. | 9.0 | 9.0 |
| Length of snout.. | .. | .. | 2.0 | 2.0 |
| Diameter of eye.. | .. | .. | 2.5 | 2.5 |
| Interorbital width | .. | .. | 3.0 | 3.0 |
| Length of caudal peduncle .. | .. | .. | 2.5 | 2.5 |
| Least height of caudal peduncle | .. | .. | 4.0 | 4.0 |

Family INDOSTOMIDAE, nov.

This new family is closely allied to the family Solenostomidae and to a certain extent to the Syngnathidae of the order Solenichthyes Regan,¹ but differs from either in several important characters. It may be defined as follows :

Highly specialised forms of small freshwater pipe-fish with a tubular trunk slightly compressed dorso-ventrally, and a long drawn out tail which is provided with a small fan-shaped caudal fin at the tip. The head is of moderate size produced into a dorso-ventrally compressed short snout. The mouth is small, terminal, slightly oblique and bordered by small intermaxillaries, maxillaries and mandibles which are roughened but without teeth. The vomer, palatines, and pterygoids are also without teeth. The post-temporal is suturally united to the skull. The verte-brae are without any articular process ; none of the anterior vertebrae are fused together or united to the skull. The body is enveloped by calcareous scutes forming distinct rings round the body. The rings, with the exception of the first or the scapular ring, correspond to the vertebrae ; the ventral plates of the first seven rings are comparatively feebly ossified. There is no lateral line. The external olfactory organ is represented by a pair of open pits situated in close proximity near the eyes. There are two dorsal fins ; both the pectoral and the ventral fins are fairly well developed, the latter being inserted below and somewhat behind the middle of the former ; the anal is situated immediately below or slightly behind the rayed dorsal. The operculum is well developed. The gill-openings are separate and moderately wide. There are four complete lobate gills. The branchiostegal rays are six in number.

Remarks.—As has been pointed out above the family Indostomidae is closely allied to the families Solenostomidae and Syngnathidae, but it differs from these families in several important characters some of which we tabulate below :—

| Solenostomidae. | Syngnathidae. | Indostomidae. |
|--|--|--|
| 1. Body compressed, tail very short with an extremely long and broad caudal fin. | 1. Body elongated, angular or laterally compressed or rounded ; tail long and prehensile in cases where the small caudal fin is absent. | 1. Body tubular, slightly compressed dorso-ventrally ; long drawn out tail with a small fan-shaped caudal fin. |
| 2. Skin with large stellate ossifications, leaving large interspaces naked, arranged in longitudinal and transverse-series, forming an uninterrupted dorsal and ventral median keels before first dorsal and ventrals, rendering the anterior part of the trunk immovable. | 2. Skin completely armoured by bony scutes, arranged regularly in series, and forming rings round the body, which, with the exception of the first, correspond to the vertebrae. | 2. Same as in Syngnathidae. |

¹ For a detailed account of the order Solenichthyes see Jungersen, H. F.—*D. Kgl Danske Vidensk. Selsk. Skrifter (Natur. Og. Math.)* Ser. 7, VIII, pp. 270-363, pls. i-vii (1910). See also Weber, M. & de Beaufort, L. F.—*The Fishes of the Indo-Austral Archipel.*, IV, pp. 7-114 (1922).

Solenostomidae.

Syngnathidae.

Indostomidae.

- | | | |
|---|---|--|
| 3. One spinous and one soft dorsal fin ; the latter opposite the anal. Both with unbranched rays. | 3. One soft dorsal (exceptionally absent), generally opposite the minute anal which is usually present. | 3. One spinous and one soft dorsal fin, the latter opposite the anal. Both with branched rays. |
| 4. Large ventrals opposite the spinous dorsal. | 4. Ventrals absent. | 4. Small ventrals below and somewhat behind the middle of the pectorals. |
| 5. One nasal opening. | 5. Two nasal openings. | 5. Two nasal openings. |
| 6. Gill openings wide. | 6. Gill openings reduced to small dorsal apertures. | 6. Gill openings moderately wide. |
| 7. Three anterior vertebrae suturally united to the skull. | 7. Three anterior vertebrae immovably joined together. | 7. Anterior vertebrae free. |

Indostomus, gen. nov.

The anterior dorsal fin consists of 5 short slender and sharp spines, one on each of the rings behind the 2nd ring. They are not connected with one another by membrane. The posterior dorsal is higher than the body and consists of 6 soft rays, all of which are branched distally. The anal fin, which is about as high as the dorsal, also consists of 6 branched rays. The pectorals are more or less rounded, and their rays are entire. The ventrals are with 1 spinous ray and 3 branched ones.

The other characters of the genus have been fully enumerated above in the description of the family.

The genus is monotypic and endemic in the Indawgyi Lake, in the Myitkyina District, Upper Burma, where the only known type-species, *I. paradoxus*, was found.

Indostomus paradoxus, sp. nov.

(Plate X, figs. 1, 2, 3.)

D₁. 5, D₂. 6. A. 6, P. 25-26, V. 1/3, C. 12.

The trunk is more or less tubular, slightly compressed dorso-ventrally, and the part from the posterior end of the dorsal fin to the base of the caudal is considerably narrow. The head and the snout are moderately compressed. On the body there are usually 22 rings of scutes, of which 8, including the scapular, lie in front and 9 caudals behind the second dorsal.

There are three pairs of cristae on the dorsum, which run parallel to one another on either side of the dorsal fins ; the innermost pair of the dorsal cristae extend posteriorly as far as the 18th scutum as a continuous ridge without any spines. The second pair of dorsal cristae run as far as the 16th scutum ; the third, or the outermost pair, is somewhat curved

outwards in the anterior half and are continuous with the superior cristae of the tail. There are two pairs of lateral cristae in the trunk, of which the superior ones curve downwards one ring in front of the insertion of the anal fin, and then run straight to terminate on the 18th ring, while the inferior cristae curves downwards about its middle and continues posteriorly as the ventro-lateral crista of the tail on each side. There is a pair of inferior cristae which can equally be described as lateral or ventral and which start slightly below the middle of the pectoral fin, curve round the middle and extend up to the 18th segment. A pair of ventral cristae start from the inner edge of the pectorals and running externally curve round the anus and then run to the tip of the caudal laterally on the sides of the anal. A low median crista is also present on the tail region starting from the end of the anal fin and terminating about the tip of the tail. The operculum is moderately arched and has 5-6 finely serrated radiating ridges.

The length of the head is contained from 3.8 to 4.1 times and the depth of the body from 9 to 9.8 times in the total length of the body without the caudal. The eyes, which are very prominent, are situated in the anterior half of the head, and their diameter is contained about 6.5 times in the length of the former. The interorbital space is slightly narrower than the diameter of the eye. The length of the snout is twice the diameter of the eye.

The first dorsal consists of 5 short, more or less stout and sharp spines, each of which has a membranous attachment at the base, but the membranes are not continuous.

The second dorsal is situated nearer the tip of the snout than the base of the caudal fin. The anal is inserted just below the dorsal and resembles it in the number of its rays. The pectoral is slightly shorter than the ventral and is more or less rounded; the latter begins below the posterior third of the pectoral. The caudal fin is fan-shaped and slightly longer than the ventral.

The lower jaw is slightly longer than the upper. Both the jaws are toothless, but there are a number of fine ridges along the outer margin of both the jaws. The gape of the mouth is equal to the diameter of the eye. The opening of the external nostrils are two narrow slits situated in front of the orbital ring.

The colour of the specimens in spirit is light olivaceous green, darker above and lighter below, and clouded with fine darkish spots all over the body. The spines of the first dorsal are blackish. Both the rayed dorsal and anal fins are banded with black and white. The pectorals and the caudal have a central blackish band, while the ventrals are blackish near the bases.

A large series of *I. paradoxus* was collected from different parts of the Indawgyi Lake and the majority of the specimens were dredged from the north end of the lake near Nyaungbin. According to Dr. Chopra's field notes the bottom of this part of the lake consisted of "hard black clay massed together in small lumps. A great deal of submerged rotten and rotting vegetation. Water is nowhere more than 14 or 15 feet; not very clear on account of the green algae floating about."

Type-series.—No. F. 11013/1 in the collection of the Zoological Survey of India (*Ind. Mus.*), Calcutta. Collected from the north end of the Indawgyi Lake near Nyaungbin.

Measurements in millimetres.

| | | | | | |
|-----------------------------|----|----|------|------|------|
| Total length without caudal | .. | .. | 25.0 | 27.0 | 26.0 |
| Length of head | .. | .. | 6.6 | 6.5 | 6.5 |
| Height of body | .. | .. | 2.75 | 2.95 | 2.95 |
| Length of snout | .. | .. | 2.0 | 2.0 | 2.0 |
| Diameter of eye | .. | .. | 1.0 | 1.25 | 1.0 |
| Interorbital width | .. | .. | 0.75 | 1.0 | 0.75 |
| Height of dorsal fin | .. | .. | 3.75 | 4.0 | 3.5 |
| Height of anal fin | .. | .. | 3.75 | 4.0 | 3.25 |
| Length of pectoral fin | .. | .. | 1.5 | 1.75 | 1.5 |
| Length of ventral fin | .. | .. | 2.0 | 2.0 | 2.0 |
| Length of caudal fin | .. | .. | 2.5 | 2.75 | 2.5 |

Family SYNGNATHIDAE.

Doryichthys dünckeri, sp. nov.

(Plate X, fig. 4.)

D. 32, A. 3, P. 18, C. 9, Rings 16+32, subdorsal rings 1+6.

The body is elongated and nearly as high as broad. The trunk region is heptagonal while the tail is tetragonal. The shields are transversely striated and their margins are fairly prominent. The intermedial shields are not prominent.

The inferior cristae of the trunk and the tail are discontinuous, while the median cristae of the trunk and the inferior cristae of the tail are continuous. The superior cristae of the trunk and the tail are discontinuous. The posterior end of the superior cristae of the trunk is continued nearly to the end of the dorsal, while the anterior end of the superior cristae of the tail extends to the first anterior ring of the tail. The ventral crista is very prominent. The operculum is more or less vaulted and has a complete longitudinal keel which is devoid of radiating ridges.

The head is nearly $\frac{1}{4}$ of the total length of the body including the caudal fin and nearly half as long as the trunk. The snout is about $1\frac{1}{2}$ times as long as the postorbital part of the head and about 3 times the diameter of the eye. The eyes are prominent and their diameter is about $\frac{1}{8}$ of the length of the head. The interorbital space is concave and half as wide as the orbit.

The tail is longer than the trunk and head. The dorsal fin is considerably less in height than the maximum depth of the body and its base is slightly elevated. The caudal appears to be rounded and is nearly $\frac{1}{2}$ the length of the postorbital part of the head.

The colour in spirit is greenish. On the trunk there is a lateral dark band on each side; another narrower band passes from the tip of the snout through the eye to the hind border of the operculum.

The single type-specimen was procured from Namkawng *charung* at Kamaing in the Myitkyina District, and is 100 mm. long including the caudal fin.

Relationships.—*D. dünckeri*, sp. nov. is closely allied to *D. caudocarinatus* M. Web., known from a single female specimen from North New Guinea, and *D. retzii* (Blkr.) which is common in different parts of Sumatra, Java, North and South New Guinea, Philippines, Bismarck Archipelago, New Caledonia, etc. The points of differences of *D. dünckeri* from these two species are shown below :—

| <i>D. caudocarinatus</i> M. Web. | <i>D. retzii</i> (Blkr.). | <i>D. dünckeri</i> , sp. nov. |
|--|---|--|
| D. 42 ; Rings 20+28 ; Subdorsal rings 2+8. | D. 34-40 ; Rings 16-17+28-31 ; Subdorsal rings 1-2+7-8. | D. 31-32 ; Rings 16+32 ; Subdorsal rings 1+6. |
| 5 radiating ridges below opercular keel. | Generally 1-2, exceptionally 3 or none radiating ridges below the opercular keel. | No radiating ridges below the opercular keel. |
| Eye about $6\frac{1}{2}$ times in head. | Eye about 5 times in head. | Eye about 6 times in head. |
| Snout slightly longer than postorbital part of head. | Snout as long as or somewhat shorter than postorbital part of head. | Snout $1\frac{1}{2}$ times longer than postorbital part of head. |
| Tail slightly shorter than trunk and head. | Tail considerably longer than trunk and head. | Tail slightly longer than trunk and head. |
| Caudal as long as postorbital part of head. | Caudal about equal to postorbital part of head. | Caudal $1\frac{1}{2}$ times in postorbital part of head. |

Type-specimen.—No. F. 11018/1 in the collection of the Zoological Survey of India (*Ind. Mus.*), Calcutta.

Family TETRAODONTIDAE.

Tetraodon cutcutia Ham. Buch.

1822. *Tetrodon cutcutia*, Hamilton Buchanan, *Fish. Ganges*, pp. 8, 362, pl. xviii, fig. 3.
 1870. *Tetrodon cutcutia*, Günther, *Cat. Fish. Brit. Mus.*, VIII, p. 290.
 1878. *Tetrodon cutcutia*, Day, *Fish. India*, p. 703, pl. olxxxii, fig. 5.
 1889. *Tetrodon cutcutia*, Day, *Faun. Brit. Ind., Fish.* II, p. 493.
 1889. *Tetrodon cutcutia*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 359.

As in the Indian specimens, the caudal fin is tipped with carmine, but there is no red spot on the throat.

T. cutcutia is common all over the lake, generally in the shallower parts, and is also found in some streams and pools connected with the lake. It is said to inhabit "clear water with sandy bottom." This fish is not used fresh but is made into *Nga-pi*, the favourite drink of the Burmese.

A large number of specimens were collected from various parts of the lake and a few from streams. The largest specimen is 74 mm. long.

EXPLANATION OF PLATE VII.

FIG. 1.—*Amblyceps horae*, sp. nov.

Lateral view of type-specimen, $\times 1\frac{1}{2}$.

„ 2.—*Glyptothorax tuberculatus*, sp. nov.

Lateral view of type-specimen, $\times 2\frac{1}{2}$.

„ 3.—*Glyptothorax burmanicus*, sp. nov.

Lateral view of type-specimen, nat. size.

„ 4.—Lateral view of *Acanthopthalmus pangia* (Ham. Buch.), $\times 3$.

„ 5.—Lateral view of *Danio* (*Brachydanio*) *rerio* (Ham. Buch.), $\times 2$.

„ 6.—Lateral view of *Badis dario* (Ham. Buch.).

FIGS. 7, 7a.—Copies of Hamilton Buchanan's unpublished figures of
“*Labrus darli*” (= *Labrus dario*).



FISH OF INDWAGYI LAKE.

A. Choudhary del

EXPLANATION OF PLATE VIII.

Akysis variegatus subsp. *variegatus*, nov.

FIG. 1.—Lateral view of type-specimen, $\times 2$.

„ 2.—Ventral view of the same, $\times 3$.

Chopraia rupicola, gen. et sp. nov.

FIG. 3.—Lateral view of type-specimen, $\times 5\frac{1}{2}$.

Parasphaerichthys ocellatus, gen. et sp. nov.

FIG. 4.—Lateral view of type-specimen, $\times 5$.

„ 4a.—Operculum removed to show suprabranchial organ.



FISH OF INDAWGYI LAKE.

A. Chowdhury & D. Bagchi del.

EXPLANATION OF PLATE IX.

Barbus ewelli, sp. nov.

FIG. 1.—Lateral view of type-specimen, nat. size.

„ 1a.—Dorsal view of anterior portion of the same, nat. size.

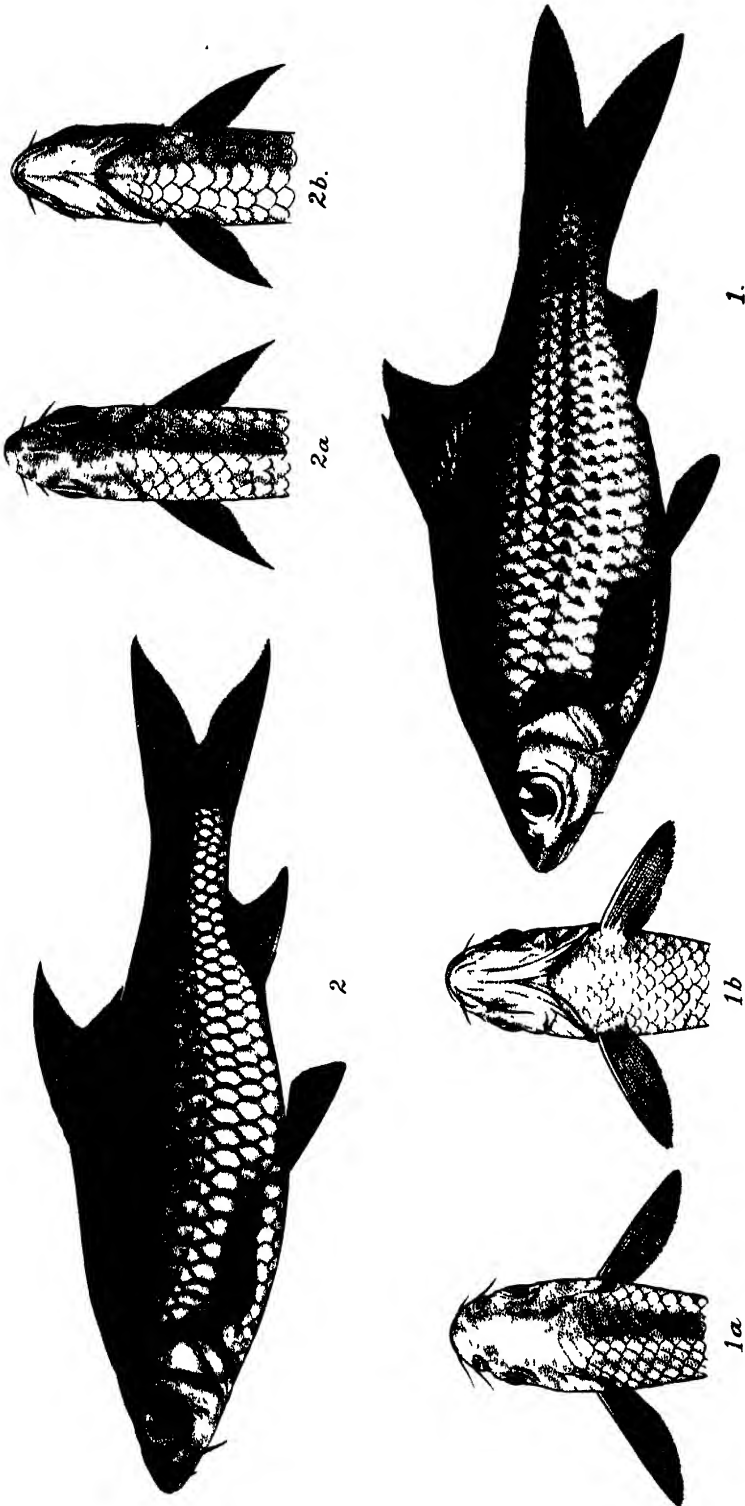
„ 1b.—Ventral view of anterior portion of the same, nat. size.

Barbus myitkyinae, sp. nov.

FIG. 2.—Lateral view of type-specimen, $\times \frac{3}{4}$.

„ 2a.—Dorsal view of anterior portion of the same, $\times \frac{3}{4}$.

„ 2b.—Ventral view of anterior portion of the same, $\times \frac{3}{4}$.



FISH OF INDAWGYI LAKE.

A. Choudhary del.

EXPLANATION OF PLATE X.

Indostomus paradoxus, gen. et sp. nov.

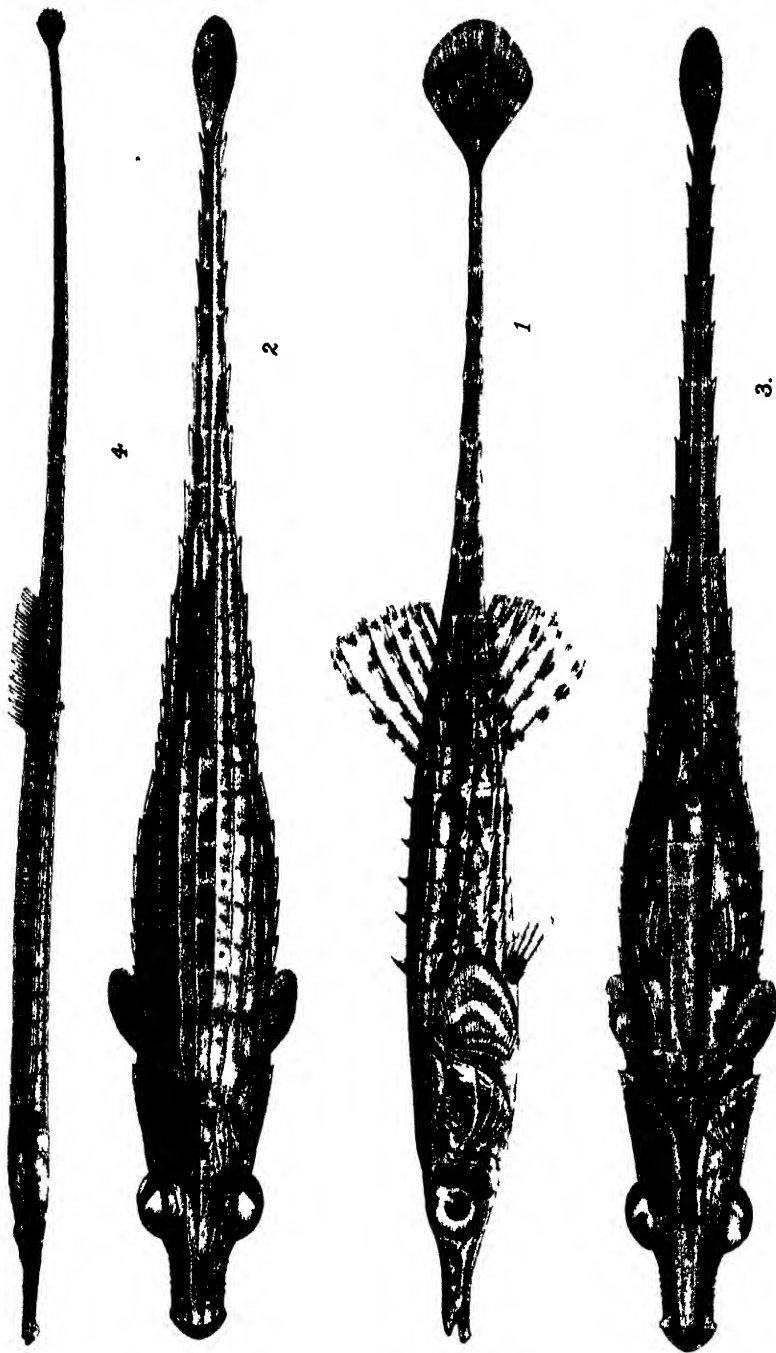
FIG. 1.—Lateral view of type-specimen, $\times 7$.

„ 2.—Dorsal view of the same, $\times 7$.

„ 3.—Ventral view of the same, $\times 7$.

Doryichthys dünckeri, sp. nov.

FIG. 4.—Lateral view of type-specimen, $\times 2$.



FISH OF INDWGYI LAKE.

THE OLIGOCHAETA OF THE INDAWGYI LAKE (UPPER BURMA).

By J. STEPHENSON, M.B., D.Sc., Lieut.-Col. I.M.S. (ret.), Lecturer in Zoology, Edinburgh University.

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INTRODUCTION.

The following paper contains an account of the Oligochaeta collected by Dr. B. Chopra in and near the Indawgyi Lake in Upper Burma during his exploration of this area in 1926.

Not much need be said by way of introduction concerning the collection. Prof. Gates's papers published during the last few years have made the Burmese fauna well known to us, and the number of new forms here described is not large.

A species of *Limnodrilus* is pretty certainly new, but the single sexual specimen did not allow a complete description, and I have therefore not given it a name. *Branchiura sowerbyi* is now coming to be recognized as a regular inhabitant of the lakes and other collections of fresh water of the Indian region and the Far East.

Notoscolex choprai, here first described, is a member of an interesting and rather narrowly localized group of species within the genus, characterized by an abnormal shifting forwards of the organs of the anterior part of the body by one segment, and the presence of calciferous glands in front of the ovarian segment.

The relations between *Pheretima anomala*, "*P. insolita*," and the forma *centralis* here described, which is practically Gates's "Type F." (Gates, '25a), have interested me; and I have interpreted *P. anomala* and "*P. insolita*" as having diverged, the one in the direction of a

male, the other in that of a female form, from a forma *centralis*, the fully hermaphrodite original.

My thanks are due to Dr. Chopra for the care he took in the preservation of the worms. They were all in excellent condition, and the present is certainly the best preserved collection that it has been my fortune to receive.

Family TUBIFICIDAE.

Genus *Branchiura* Bedd.

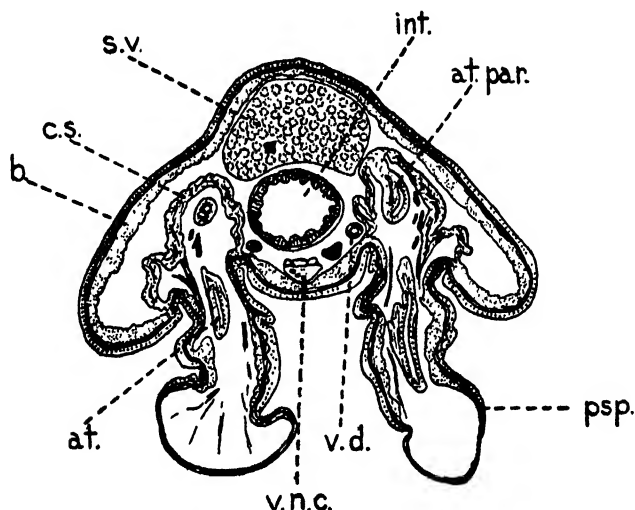
Branchiura sowerbyi Bedd.

Indawgyi Station 7; dredging in the Indawgyi Lake along its western shore near Loimon, Myitkyina Dist., Upper Burma. B. Chopra. 4-5. xi. 26. Numerous fragments, the worm or worms apparently having undergone autotomy.

Indawgyi Station 3; dredging in the Indawgyi Lake at its south end and along its eastern shore near Lonton, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Several fragments.

The same. A large number of fragments, those of the anterior end mostly sexual. Indawgyi Station 10; dredging at the north end of the Indawgyi Lake, Myitkina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Three small fragments.

In the majority of the fragments which contained sexual organs (second tube from Indawgyi Station 3) the "pseudopenes" were seen projecting.



TEXT-FIG. 1.—*Branchiura sowerbyi*; transverse section through segm. xi, to show everted pseudopenes; $\times 34$ (Abbe's drawing apparatus). *At.*, atrium within coelomic sac; *at. par.*, atrium and paratrium together, before union, just after entering coelomic sac; *b.*, body-wall, with the three layers, epithelium, circular and longitudinal muscular coats; *c.s.*, muscular wall of coelomic sac, which by its contraction causes extrusion of pseudopenis; *int.*, intestine; *psp.*, pseudopenis, the everted ectal portion of atrium; *s.v.*, seminal vesicle (sperm sac) containing sperm morulae; *v.d.*, vas deferens; *v.n.c.*, ventral nerve cord.

I described the "pseudopenes" in a previous paper ('18), and gave a diagrammatic figure to illustrate the mechanism of protrusion (by eversion of the terminal portion of the atrium). My sections of the present specimens give a particularly clear view of the relations of the parts in protrusion, and I reproduce here (fig. 1) one of the transverse

series in illustration. It seems quite evident that whatever may be the function of the pseudopenes, they are far too voluminous to be used as intromittent organs.

Genus *Limnodrilus* Clap.

Limnodrilus sp.

Indawgyi Station 7 ; dredging in the Indawgyi Lake along its western shore near Loimon, Myitkyina Dist., Upper Burma. B. Chopra. 4-5. xi. 26. Numerous specimens, none sexual.

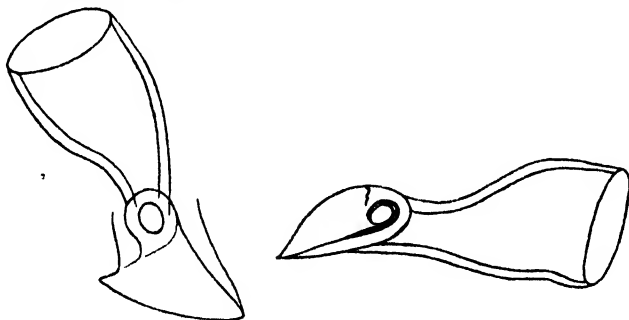
Indawgyi Station 3 ; dredging in the Indawgyi Lake at its south end and along its eastern shore near Lonton, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. A number of specimens, one with sexual organs.

Indawgyi Station 10 ; dredging at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. One complete worm and the anterior end of another, neither sexual.

The worms are filiform, very long in proportion to their thickness, the hinder part in particular being extremely thin and thread-like. The length is 80, 90, 100, or 120 mm., while the maximum diameter (towards the anterior end) is only about 0.5 mm., or at most 0.75 mm.

The prostomium is roughly triangular, with a blunt rounded anterior end.

The setae in both dorsal and ventral bundles are double-pronged crotchets, as usual in the genus. In the anterior part of the body (up to segm. viii in the sexual specimen, or up to xi in the others) there are two or occasionally three setae per bundle, but in the middle and hind regions each bundle consists of only a single seta. The proportions of the prongs vary ; the distal may be twice as long and twice as thick at the base as the proximal, but further back in the same specimen the two were more nearly equal. The nodulus is frankly distal (distal : proximal : : nearly or quite 1 : 2).



TEXT-FIG. 2.—*Limnodrilus* sp. ; chitinous penis sheaths, one drawn from one side, the other from the other side of the body.

In the anterior segments (i-vii, and again in ix and x) there are complicated parietal vascular loops ; possibly there are hearts in viii, but I cannot say that they were clearly distinguished. Parietal vessels, if present, were not visible in the hinder region of the body.

The spermathecal apertures are on segm. x, and the male pores on xi. The shape of the chitinous penis sheath could be seen in the only sexual specimen, which was examined in cedar oil, and is represented in fig. 2 ;

it is short,—only about twice as long as broad at its widest part,— and twice as wide above as below ; there is a one-sided lateral expansion at its lower end.

Remarks.—The only *Limnodrilus* known from the Indian region is *L. socialis* Steph., which is widely spread, occurring from the north to the south of India, in Burma, and in Japan. From that the present species differs widely in the number of setae per segment and in the shape of the chitinous penis sheath. The single sexual specimen unfortunately did not cut well, and I am unable to add anything to the short account written from the examination of the specimen in cedar oil ; I think, however, that the two peculiarities I have just mentioned will allow of the present form being recognised when it is met with again.

It is remarkable that this worm should have been found, on each of the three occasions, in the same localities as *Branchiura sowerbyi* ; and in this connection it may be recalled that I found *Branchiura sowerbyi* associated with another *Limnodrilus* (*L. socialis*) both at Lahore and in a consignment of worms brought by Annandale from Kyoto, Japan (Stephenson, '12, '17).

Family MONILIGASTRIDAE.

Genus *Drawida* Mich.

Drawida longatria Gates.

Kamaing, Myitkyina Dist., Upper Burma. B. Chopra. Nov.-Dec., 1926. Three specimens, sexually mature.

This species was originally described by Gates ('25), and is again referred to in later papers (Gates, '26, '26a). The present specimens show a number of not altogether negligible variations.

The worms are smaller than those originally described by Gates ; in length they measured 77, 95, and 105 mm., in diameter 3.5 mm. The longest had 168 segments, but was perhaps incomplete posteriorly ; the next longest had 183.

The specimens (unlike former examples) showed indications of dorsal pores (cf. *D. barwelli*, *D. nepalensis* and *D. rosea*). These began behind the clitellum as dark spots, and in some of these spots I think there was a patent passage through the body-wall ; the dried surface became moist on putting the contents of the body-cavity under pressure by bending the worm,—though possibly this might have been due to an oozing through the parietes.

The ventral setal bundles of the original examples seem to have been closer together than in the present specimens. Here, in the hinder and middle part of the body, *aa* is slightly less than (almost equal to) *bc*, and *dd* is equal to four-sevenths of the circumference ; in the anterior region *aa=bc*.

In furrow 10/11 are a pair of large blunt rounded papillae each of which forms part of a more extensive elevation, longer than broad, which takes up the greater part of the length of segms. x and xi. The papillae are situated between the lines of setae *b* and *c*, the centre of the papilla

being nearer to *b* than to *c*, and the transverse extent of the papilla equal to about the inner two-thirds of the interval *bc*. The surface of the papilla is occupied by a slightly convex oval area, the long axis of the oval being longitudinal; this area is sharply delimited at its margin by a well marked narrow groove. These papillae appear to be the porophores, though the exact situation on them of the male pores is not obvious.

The spermathecal apertures, in furrow 7/8, are conspicuous, bounded by prominent lips, the middle of the slit-like apertures being in line with seta *c*.

There are in these specimens no papillae on segm. viii, as in the original examples. In one of my three specimens there are, on segm. xi and rather on its anterior portion, a pair of fairly conspicuous indefinite whitish swellings of moderate size, situated mainly external to the line of the ventral setae but extending inwards so as to include this line.

The number of gizzards in the specimen I dissected is five,—one more than in the original description.

The greater part of the vas deferens is so disposed as to form a large mass of small lamellae,—in places perhaps best described as cauliflower-like,—larger than the kidney-shaped testis sac, to the hilus of which it is attached. I found the prostate smooth and shining, not (as Gates) finely granular. The parts of the ovisacs in segm. xii were much swollen and full of ova.

***Drawida nepalensis* Mich.**

Rocky stream about half a mile from Namina rest house, Myitkyina Dist., Upper Burma. B. Chopra. 15. x. 26. Four specimens, one very small and immature.

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Four specimens, all sexual.

The habitat of the first batch,—in a rocky stream,—is interesting as an example of the predilection of the genus for water (cf. on this subject Stephenson, '23, p. 34). These were very small specimens, the largest 43 and 48 mm.; while those of the second batch are 90-100 mm.

The indications of dorsal pores begin in both batches behind the clitellum. The pores are represented by dark spots, and there may be a slight pitting, but no fluid comes through on pressure.

In two specimens of the second batch the clitellum is immediately obvious, being coloured a rather pretty rose tint. In this batch a pair of small transverse depressions, each bounded by a raised lip, is situated a little behind furrow 7/8, each depression being in line with the spermathecal pore in front of it. The depressions are not of much greater extent than the slit-like apertures; that of the right side is absent in one of the two clitellate specimens, and both are wanting in one of the others.

The gizzards, in the dissected specimen of the first batch, are three in number, in segms. xiv-xvi, while in the dissected specimen of the other batch there are only two (as in Michaelsen's specimens from Java; Michaelsen, '24).

The spermathecal duct is (first batch) disposed in irregular windings, which are loosely attached to the septum.

Family MEGASCOLECIDAE.

Subfamily MEGASCOLECINAE.

Genus *Notoscolex* Fletcher.*Notoscolex choprai*, sp. nov.

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Two specimens, mature.
 Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Four specimens, mature.

External Characters.

The two specimens of the first batch are 190 and 220 mm. long ; those of the second are respectively 430, 290, 212, and 180 mm.,—one being thus very considerably longer than any of the others. The maximum diameter is 5 to 6.5 mm. Segments (of a specimen of average length) 304. Colour a fairly uniform grey, hinder end lighter ; clitellum purple.

There is a very distinct secondary annulation of the anterior segments, which is particularly confusing, since the setae are here very small and seen only with difficulty. I have however succeeded in making out the complete series of setal bundles in more than one specimen, and find that segms. i, ii and iii consist of a single annulus each, segm. iv of two, v of two or three, vi of three or four, vii-xi of four, and xii of three or (counting two slighter furrows) five.

The prostomium is small and prolobous ; segm. i is marked by a number of short longitudinal grooves all round its anterior margin.

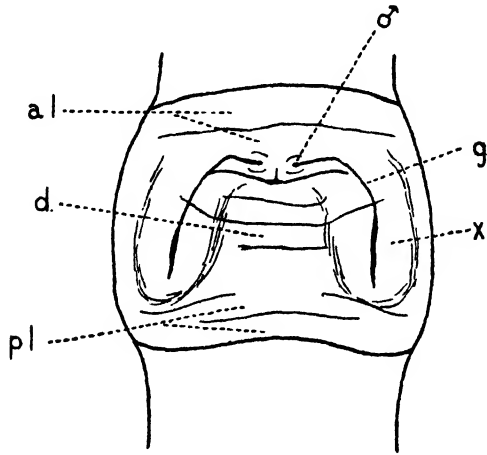
Dorsal pores begin from furrow 9/10.

The setae are small and paired ; *ab* is equal to one-third of *aa*, but varies somewhat in different parts of the body, perhaps owing to irregular contraction ; it is equal to a half to two-fifths of *bc*, and is almost equal to *cd* ; *dd* is about two-thirds of the circumference ; *aa* is relatively smaller in front of the clitellum.

The clitellum extends over segms. xiii- $\frac{2}{3}$ xvi ($=3\frac{2}{3}$) ; thus it (and the genital apertures) are one segment further forward than is usual in the genus. It is purple in colour and well defined,—limited behind by a constriction which excludes a sharply defined annulus of segm. xvi from the clitellar region. Dorsal pores are visible on the clitellum.

The male area (fig. 3) includes the whole ventral surface of segms. xvii and xviii, with the posterior third of segm. xvi. In shape the area is almost quadrangular, the anterior end being narrower and the anterior angles rounded off ; the whole area is about one-fourth wider than long. The periphery of the area is raised, forming a very broad and tumid border surrounding a central depression, of the same shape as the whole area. The bottom of the area is somewhat furrowed transversely ; there is also a transverse furrow on the anterior lip of the area, a second, bent somewhat backwards in its middle part, delimiting the anterior lip from the central depression, and sometimes a third on the posterior lip. The lateral lips are particularly broad ; each has a well

defined clean longitudinal cleft or furrow, of some length, along its middle, best marked in its posterior portion; this cleft is continued



TEXT-FIG. 3.—*Notoscolex choprai*; the male area. *A.l.*, anterior lip, with transverse groove; *d.*, central depression; *g.*, groove leading to male pore, ♂; *p.l.*, posterior lip, also with transverse groove; *x*, lateral lip around posterior end of groove (forming almost an independent papilla).

forwards and bends inwards towards the middle line, ending in a pore—the male pore—not far from its fellow of the other side, in front of the short transverse groove between anterior lip and central depression. The male pores are thus on segm. xvii, on the posterior aspect of the anterior lip of the male area; but this region may overhang the central depression, so that in a strictly ventral view the pores are concealed.

The female apertures are near each other in a whitish transversely oval area on the anterior portion of segm. xiii.

The spermathecal pores are inconspicuous, deeply situated in furrows 6/7 and 7/8 near the middle line, slightly internal to the line of seta *a*.

Internal Anatomy.

Septum 4/5 is thin, 5/6 slightly thickened, 6/7, 7/8, 8/9 and 9/10 very thick and muscular, 10/11 somewhat and 11/12 slightly thickened; one or two still further back are perhaps slightly thickened also.

The gizzard is large, elongated, cylindrical or slightly barrel-shaped, in segm. vi. Calciferous glands are present in segms. x, xi and xii, the first pair flattened antero-posteriorly, and all somewhat kidney-shaped. The intestine begins in xiv.

The last hearts are situated in segm. xii.

There are numerous small micronephridia. In the anterior segments tufted nephridia are present; and at the hinder end there is, in addition to numerous micronephridia, a pair of larger loops per segment; but I almost missed these, in consequence of their being closely applied to the intestine (not lying on the body-wall in the dissection), and hence inconspicuous.

The male funnels are free, in segms. ix and x ; testes were not identified. The seminal vesicles are two pairs, in x and xi, of moderate size, meeting in the mid-dorsal line, smooth and not cut up into lobes.

The prostates are compact glands situated in segments xvi-xx, but may push the anterior and posterior septa respectively of these segments somewhat forwards and backwards ; in the dissected specimen the two glands were not quite at the same level. The outer margin of the posterior part of the gland appears lobed because of constrictions due to the septa. The duct is given off from the anterior portion of the gland ; it is short and bent, the loop having its blind end directed forwards on one side, backwards on the other ; it is soft, not muscular, and ends under cover of a strong sheet of oblique muscle bands situated on the body-wall within the circular muscle layer. There are no penial setae.

The ovaries are in segm. xii.



TEXT-FIG. 4.—*Notoscoler choprai* ; spermatheca.

The spermathecae (fig. 4), situated in segms. vi and vii, or both in vi (the greater part, at least, of the posterior spermatheca of the left side was in vi in the dissected specimen), open quite near the middle line. The ampulla is a simple sac ; the duct is short and moderately stout ; there is a single diverticulum, shortly club-shaped, given off from the anterior side of the upper end of the duct.

Remarks.—The shifting forwards of the organs of the anterior part of the body by one segment, and the position of the calciferous glands in front of the ovarian segment, place this species in the *stewarti* group (*N. stewarti*, *striatus*, *oneili*, *birmanicus*). From *N. stewarti*, to which it has the greatest resemblance, it is distinguished by its larger size, by the extent of the clitellum, the characters of the male field and the relative proportions of the spermathecal ampulla and diverticulum.

The whole *stewarti* group is, so far as known at present, confined to the Abor region and Upper Burma.

Genus *Pheretima* Kinb.

Pheretima andersoni Mich. var. *choprai*, n. var.

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Two specimens, sexually mature.

External Characters.

Length 132-138 mm. ; maximum diameter 5 mm. Colour brownish purple dorsally, rather paler behind ; pale ventrally ; clitellum rather

more distinctly purple. Segments 118 and 119; some slight irregular secondary annulation in some of the preclitellar segments.

Prostomium large, broad, epilobous $\frac{1}{3}$; the tongue not delimited behind.

Dorsal pores begin in furrow 12/13.

The setae are very small, very numerous, arranged without dorsal or ventral break, and equally closely set dorsally and ventrally; I counted them as follows:—69/ix, 72/xii, 81/xix, and 90 in the middle of the body, while towards the hinder end they were particularly numerous and close-set, 100 or more per segment.

The clitellum, extending over segms. xiv-xvi (=3), is purple in colour, smooth, and without dorsal pores or setae.

The male pores are about two-sevenths or nearly one-third of the circumference apart, with 14-16 setae intervening; they are situated on large round porophores, which take up the whole length of the segment.

The female aperture is midventrally situated, in one specimen in a short transverse furrow, in the other appearing as a mere oval depression.

The spermathecal pores are four pairs, in furrows 5/6-8/9, more than one-third of the circumference apart and nearly in the lateral line.

Over furrow 21/22, in the specimen first examined, are a pair of large flat circular papillae, extending lengthwise from the setae of xxi to those of xxii, and indeed causing the setal rows to bulge apart slightly; the outer borders of the papillae are about in line with the centres of the male porophores; the borders are very slightly elevated and whiter in colour than the centres of the papillae. In furrows 22/23, 23/24 and 24/25 is a series of unpaired papillae, midventrally situated, similar to but slightly smaller than the paired papillae, very slightly broader than long, nearly touching their neighbours in front and behind,—i.e., each nearly equal to a segment in length.

In the second specimen the paired papillae are similarly placed; the unpaired papillae are six in number,—one very small one in furrow 18/19; the three over 22/23, 23/24 and 24/25 as large as those in furrow 21/22 and distinctly oval in shape, their transverse extent being almost equal to the transverse interval between the paired papillae; and two, over furrows 25/26 and 26/27, considerably smaller, especially the last, which is a little to the left of the middle line.

Internal Anatomy.

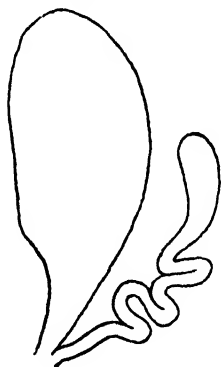
The differences from the type form of the species are as follows:—Septa 3/4, 4/5, and 5/6 are thin (5/6 appearing thickened because covered on its anterior face by a layer of nephridial tubules), 6/7 is similar to 5/6, 7/8 slightly thickened; the next is 10/11, which along with 11/12 is somewhat thickened.

The caeca originate in segm. xxvii.

The last hearts are in segm. xiii (not xii).

The chief difference in the male organs is that there were, so far as I saw, no seminal vesicles in segm. x; those in xi and xii are not cut up into lobes.

The spermathecal ampulla (fig. 5) is an ovoid sac, not sharply delimited from the duct, which is quite short though easily recognizable, only a



TEXT-FIG. 5.—*Pheretima andersoni* var. *choprai* ; spermatheca.

fraction of the length of the ampulla, and narrowing to its termination. The diverticulum originates at the extreme ectal end of the duct ; it is tubular, dilated in a club-shaped manner at its ental end, and thrown into a few closely apposed loops or winding irregularly in its middle portion ; in length, if extended, it would nearly equal the ampulla and duct together.

Remarks.—The differences of the present variety from the type form of the species are the smaller size, the paired papillae on furrow 21/22 (instead of a single median papilla), and the more elongated spermathecal ampulla ; the much smaller degree of thickening of the septa, and the situation of the last heart in segment xiii may also be mentioned.

***Pheretima anomala* Mich.**

Hopin, Myitkyina Dist., Upper Burma. B. Chopra. 12-13. x. 26. Two specimens, mature.

The genital papillae do not extend back behind segm. xxi ; in one specimen there is a pair of papillae on xvii,—one segment further forward than usual.

The distribution of the testes and male funnels was also abnormal ; they were present in segms. v, vi, vii, viii, one pair in the combined segments ix-x (there being apparently no septum 9/10), and one pair in xi ; but the last two pairs, instead of being, as usual, enclosed in testis sacs, were free, like those in front of them.

A large number of small round yellowish bodies seen through the thin body-wall in the hinder third or half of the worm were found, on opening the specimen, to be mostly adherent in a layer to the inner surface of the body-wall ; they were simply masses of *Monocystis* spores (pseudonavicellae) along with some granular matter.

***Forma centralis*, nov.**

Nyaungbin, a village at the north end of Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Three specimens, mature.

In the first specimen examined, there was a large and prominent papilla (male porophore) on the left side of segm. xx, while smaller

papillae were present on the left side of segms. xvii and xviii, and on the right side of segms. xviii and xx. On the left side of xix and on the right side of xvii and xix there were no definite papillae, but small transverse slit-like apertures were present, sometimes on slight elevations.

In the second, the male pores on segm. xx were not on porophores, but were distinguishable by being slightly internal to the other apertures, which were small and slit-like, faintly visible on both sides on segms. xvii-xix, on xxi and xxiii on the right side only.

In the third, the male porophores were on xx, and small slits were present on both sides on xvii, xviii and xix.

Internally, I could not discover any trace of septa 8/9 and 9/10.

The testis sacs, two pairs, in segms. x and xi, are all separate from each other ; there are no supernumerary testes. The vesiculae seminales, in xi and xii, are of moderate size, with a few shallow lobulations. The prostates are of moderate size, extending from segm. xix to xxii, and are deeply cut up into lobes ; the duct forms a single loop, with its blind end pointing forwards, the ental limb narrow and not shining, the ectal limb shining and becoming much thicker. There is no copulatory pouch

There are three pairs of accessory prostates (in the dissected specimen) in segms. xvii, xviii and xix respectively,—rounded and rather mushroom-like in shape, each with a very stout duct-like portion, soft yet shining and apparently muscular.

Ovaries and funnels are present in segm. xiii ; the ovaries are flattened and rather disc-like, and are attached by the middle of their anterior surface to the posterior face of septum 12/13.



TEXT-FIG. 6. —*Pheretima anomala* f. *centralis* ; spermatheca.

The spermathecae (fig. 6) are three pairs, opening in furrows 5/6, 6/7 and 7/8. The ampulla is a much elongated narrow sac ; the duct is not distinctly marked off, but may be said to be half or two-thirds as long as the ampulla. The diverticulum, tubular, sinuous, with knob-like ental end, enters the extreme ectal end of the duct, and if straightened out would extend beyond the end of the ampulla.

Remarks.—Miss G. E. Pickford recently drew my attention to the remarkable *Pheretima speiseri* Mich. from New Hebrides in which Michaelsen ('13) has described a form A without male pores or prostates (but possessing the anterior male organs), and a form B with male pores and prostates but with reduced spermathecae; she remarked (*in litt.*) that this looked very like a case of secondary bisexuality,—the hermaphrodite form having differentiated in two directions, so that the form A was losing its male organs (becoming predominantly female), and the form B its female organs (becoming predominantly male). She has herself described ('29) a form C, which is fully hermaphrodite, and is, therefore, to be looked on as the central form from which the others are being separated off.

The present is a parallel case. In 1909 Michaelsen described *Pheretima anomala* from Sibpur near Calcutta, in which, while the testes are actually in larger number than normal, the female characters are disappearing, spermathecae being entirely absent. Though of course there are many earthworms which are normally without spermathecae, it is possible nevertheless that the forms described by Michaelsen function only as males.

In 1925 Gates ('25a) described from Rangoon, along with *P. anomala*, certain specimens to which at the time he did not give a specific name (later called *P. insolita*), in which on the contrary certain of the male organs were in a state of regression; the prostates and accessory prostates (mushroom glands) were absent, there were no copulatory papillae nor visible male pores, and the vas deferens was much attenuated towards its end, dwindling to a very fine thread, exceedingly difficult or sometimes impossible to trace,—indeed it “cannot be traced with certainty to an external pore in any of the dissections.” Such specimens can hardly act as males, in view of the absence of visible male pores, and of the fact that a viscid fluid requires a tube to be of a certain calibre if it is to pass along it. They are therefore functional females,—a view which is borne out by the fact that they were only found by Gates ('25a) in localities from which *P. anomala* was also obtained.

Gates also found a number of specimens with a single small prostate or a pair, with a single mushroom gland, or with a mushroom gland and a small prostate. Some specimens (type F) had a fully developed pair of prostates, and the normal number of mushroom glands, but lacked the characteristic copulatory papillae of *P. anomala*, possessing instead pores with puckered lips.

This latter condition is that of two out of three of my present specimens. My third specimen, however, had a certain number of copulatory papillae, and thus represents the original hermaphrodite form from which presumably both *insolita* and *anomala* have been derived, the one (*insolita*) by suppression of certain of the male characters, the other (*anomala*) by suppression of certain female characters.

I think it is necessary to unite all the forms here discussed under one species, *Pheretima anomala* Mich.; the forms lacking spermathecae (possibly functional males), originally described by Michaelsen, will constitute the forma *typica*; the functional females will be the f. *insolita*.

(Gates) ; and the central form from which both the above have diverged, comprising Gates's type F and the specimens described above, may be called *P. anomala f. centralis*.

***Pheretima elongata* (E. Perr.)**

Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Seven specimens, mature.

***Pheretima houlleti* (E. Perr.)**

Kamaing, Myitkyina Dist., Upper Burma. B. Chopra. Nov.-Dec., 1926. A number of specimens.

Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Six specimens.

In 1900 Michaelsen united Rosa's *Perichaeta campanulata* with *Pheretima houlleti* under the latter name ; but Gates later ('27) showed that they ought to be kept separate. The present specimens belong rather to the species *houlleti* than to *campanulata* ; I give a few notes on certain features, including those which are diagnostic of the two species.

The longest specimen measures 142 mm. ; the maximum diameter is 3.5 mm. The dorsal and ventral setae of segms. ii-ix are not irregularly placed to any notable extent ; the setae are more closely set dorsally. The ventral setae of segms. ii-ix are larger than usual, and are modified in shape,—not always in the same way ; there is no definite nodulus, and in some there is a fine ornamentation of delicate transverse markings (? each a fine series of points) near the tip. The dorsal and ventral breaks are small and irregular, the average extent of these being $1\frac{1}{2}$ *ab* and $1\frac{1}{2}$ *yz* ; in general the setae are small ; the following numbers were counted :—31/v, 47/ix, 54/xii, 52/xix, and 52 in the middle of the body. The number of setae intervening between the male pores varies from 4 to 12, and the distance apart of the pores from one-fourth to one-third of the circumference.

No penial setae were discoverable.

The testis sacs of each segment, x or xi, are widely separate, the sacs of xi reach anteriorly to and join septum 10/11, on the anterior side of which are situated the testis sacs of segm. x ; but whether or not there is a connection through the septum between the sacs of xi and x could only be ascertained from a series of sections.

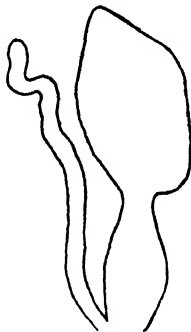
Small white glandular masses ("accessory prostates") are attached to and open into the copulatory chamber.

The number of spermathecae is variable,—either two or three pairs, or two on one side and three on the other. The windings of the spermathecal diverticulum are somewhat irregular, and are not usually all in the same plane, though they may be so or nearly so. The stalked accessory gland in connection with each spermatheca may be absent,—in one of the two specimens dissected (which had only two pairs of spermathecae) none of the organs was accompanied by a stalked gland.

***Pheretima lignicola* Steph.**

Hopin, Myitkyina Dist., Upper Burma. B. Chopra. 12-13. x. 26. Two specimens, sexual.

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Six specimens, sexual.



TEXT-FIG. 7.—*Pheretima lignicola* : spermatheca.

The spermathecal diverticulum in the specimen dissected (from Hopin) (fig. 7) is longer and more simply tubular than originally described by me,—just about as long as ampulla and duct together.

***Pheretima peguana* (Rosa).**

Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Three specimens, sexual.

***Pheretima planeta* Gates.**

Kamaing, Myitkyina Dist., Upper Burma. B. Chopra. Nov.-Dec., 1926. Numerous specimens, mostly sexually mature.

Loinon, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 2-5. xi. 26. Numerous specimens, none fully mature (at least none with clitellum).

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Two specimens, sexual.

Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Numerous specimens, sexual.

Genus *Perionyx* E. Perr.***Perionyx excavatus* E. Perr.**

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Numerous specimens, mostly without or with only slight sexual marks, a few more advanced.

Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Several specimens.

The specimens were of larger size than usual,—those from Nyaungbin up to 125 mm., and those from Lonton up to 175 mm. The limits previously recorded seem to be 23-120 mm.

A single immature specimen of a *Perionyx* was taken at Loinon, on the western shore of the lake, and may quite possibly have belonged to the same species. It was 133 mm. in length; the male pores were barely indicated, on segm. xx; and the female pore was represented by a slight depression on xvi; these positions are of course abnormal, but there are in fact large variations in the situation of the genital apertures in *P. excavatus*.

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ON THE GYRINIDAE OF THE NERBUDDA RIVER.

By GEORG OCHS, *Frankfurt a/Main.*

Through the kindness of Dr. Hem Singh Pruthi, Assistant Superintendent, Zoological Survey of India, Calcutta, a large collection of Gyrinidae, made during the survey of the Nerbudda river, was placed in my hands for identification. The collection contains no new species, which seems to indicate that we are already pretty well acquainted with the Gyrinid fauna of India. For this credit is due to the great zeal of Indian collectors and to the praiseworthy activity of the scientific institutions in India for sending the material promptly to specialists for study. Nevertheless the collection has proved of great interest, as, except for a small collection received sometime ago from Dr. C. F. C. Beeson of the Forest Research Institute at Dehra Dun, practically no members of the family have previously been collected from the Central Provinces of India.

***Gyrinus convexiusculus* Macleay.**

Sta. 1. Rewa State, 3,300 ft., Amarkantak, a big tank—the source of the Nerbudda river. I/1927. (Hem Singh Pruthi). 1 specimen.

Sta. 5. Rewa State, 3,300 ft., Amarkantak, (*id.*). 2 specimens.

Sta. 12. Rewa State, 3,300 ft., a big pool near Amarkantak. I/1927. (*id.*). 96 specimens.

Sta. 13. Rewa State, 3,000 ft., $\frac{1}{2}$ mile beyond Dhud Dhara falls. II/1927. (*id.*). 3 specimens.

Sta. 16. Rewa State, 3,300 ft., Baralnala, a tributary of the river, $1\frac{1}{2}$ miles from Amarkantak. II/1927. (*id.*). 20 specimens.

Sta. 30. Rewa State, 2,700 ft., near Sarai. II/1927. (*id.*). 8 specimens.

—Rewa State, Umaria, Jaithari Range, 19-xi-1927 (C. F. C. Beeson).

This is a widely distributed species, which was described from Australia. It was later recorded from New Zealand as *huttoni* Pascoe, and occurs in New Caledonia, Sumatra, Annam and Ceylon. It is also stated to occur in South-China and Tibet, and I have seen a single specimen labelled "Java," but this record appears doubtful. Other Indian localities are: Madras; Madras Town, X/1913 (1 specimen flew into a finger-bowl on a dinner table); Palni Hills, Poubat-Havangi, 6,900 ft., 27-viii-1922 (Kemp); Nilgiri hills, Coonoor river, 1-xi-1924 (Bhasin); Mysore, 4,100 ft., 25-iii—29-iv-1913 (P. S.); Bangalore (Cameron), 21—25-i-1924 (Fletcher), 20-viii-1925 (Beeson); Bombay Pres., Satara dist., Medha, *ca.* 2,200 ft., Yenna Valley, 27-ii—4-iii-1918, in small pools at the edge of the river (Annandale); Eastern Himalayas (R. P. Bertrand); Himalayas (R. P. Castets, 1904); Nepal, Soondrijal, x-1906 (R. Hodgart); S. Shan States, 4,000, 4,500 ft., Burma; Hsamonghkam, 13—14-ii-1917; Kalaw, 10-iii-1917 (Gravely).

The older authors confounded this species with *G. nitidulus* Fab., which, though closely allied, is however specifically distinct and inhabits the Isles of Mauritius and Reunion. Other allied species are found in Madagascar and in South-Africa.

Dineutus (Gyrinodineutus) unidentatus Aubé.

Sta. 39. Rewa State, 3 miles from Koilari, 2,650 ft., II/1927. (H. S. Pruthi). 1 specimen.

The type-locality of the species was given as Brazil, but this is certainly erroneous. It is widely distributed in India and also occurs in Ceylon, Siam, Tonkin, China, Java and the Philippine Islands (as subsp. *curtus* Reg.). The various Indian localities from where it has been collected are:—Bengal: Calcutta; Berhampore Court; Konbir (P. Cardon); Bowring; Sherpur Town, Mymensingh, 28-x-1909 (Chaudhuri); Chota-Nagpur: Manbhum (K. Hallowes); Orissa-Coast: Puri, 14—27-x-1923 (S. L. Hora & B. N. Chopra); Chilka Lake, Sta. 139; Ganjam dist., Rambha, 21-ix-1913 (Annandale); Madras: Pondichery; Tranquebar (Daldorf); Madura; Karachi (teste Kerherve); U. P., Lucknow, 8-xi-1907, 22-i-1908; Bihar: Pusa, 1-xi-1916, in river (Singh), 28-x-1921, 27—29-iii-1924 (Rangi); Purneah dist., Kierpur, 13-ix-1915, in flooded paddy field (Paiva), Burma; Peninsular Siam; Perak.

A closely allied species, *D. subspinosus* Klug, occurs in Mauritius, Madagascar and Africa. It is, like the preceding species, a typical example of migration of these beetles from Malaya to Africa across the land-bridge of the earlier geological times—Lemuria.

Dineutus (Protodineutus) indicus Aubé.

Sta. 4. Rewa State, a southern tributary of the river, one mile from Amarkantak, 3,300 ft., I/1927. (H. S. Pruthi). 7 specimens.

Sta. 7. Rewa State, the Sone river at Amarkantak, I/1927. (*id.*). 39 specimens.

Sta. 11. Rewa State, just beyond the Kapildhara falls, 3,300 ft., I/1927. (*id.*). 25 specimens.

Sta. 63. Centr. Prov., Mandla dist., Kharmer Nullah, about a mile below Sakka, 9-vi-1927. (B. N. Chopra). 2 specimens.

—Rewa State, Amarkantak, 3,500 ft., 21-xi-1927 (C. F. C. Beeson).

—Rewa State, Umaria, Rewa, Lalpur, in stream, 19-xi-1927 (C. F. C. Beeson).

This species occurs throughout India from Ceylon to the Himalayas and from Baluchistan to Assam and has been collected from numerous localities.

The subgenus, to which this species belongs, is an African one, and a very closely allied species has been collected in Hadramaut (S. Arabia). These records appear to indicate that this is probably a case of re-emigration from Africa to India *via* Arabia at a probably much later date than that of the migration of *D. (G.) unidentatus* from Malaya to Africa referred to above.

Orectochilus haemorrhous Rég.

Sta. 39. Rewa State, 3 miles from Koilari, 3,650 ft. II/1927. (H. S. Pruthi), thousands of specimens.

Sta. 42. Rewa State, near Khetgaon, 2,650 ft., II/1927. (*id.*). 3 specimens.

Sta. 63. Centr. Prov., Mandla dist., Kharmer Nullah, about a mile below Sakka, 9-vi-1927. (B. N. Chopra). 1 specimen.

Sta. 65. Centr. Prov., Mandla dist., Burhner river near Mohgaon, 1,500 ft. XI/1927. (H. S. Pruthi). 1 specimen.

Sta. 75. Centr. Prov., between Dupla and Gorakpur, 1,500 ft., XI/1927. (*id.*). 25 specimens.

Sta. 87. Centr. Prov., at Padmi, XII/1927. (*id.*). 3 specimens.

Sta. 96. Centr. Prov., at Barham Kalan, current slow, XII/1927. (*id.*). 4 specimens.

This species was described from Madras and has since been taken at Bangalore, 3,000 ft., 12-x-1910 (Annandale); Travancore: Alleppey,

from pond, I/1928 (H. S. Rao & M. Sharif); Chota Nagpur : Chaibassa, Singhbhum dist., 2—3-iii-1923 (F. H. Gravely) and Chakradharpur, Sanjai river, 8—10-ii-1918 (N. Annandale & F. H. Gravely); Bihar : Pusa, 23-iii-1926 (G. P. Pillai).

Régimbart records a varietal form from the lower reaches of the Himalayas (Castets, 1904) and it seems that the specimens from Pusa are very near it. The large series from Rewa State, Sta. 39, exhibits, however, a great degree of variation in the inner outline of the tomentous border of elytra, and I doubt whether it is possible to separate the varietal form, which is mainly based on this character.

***Orectochilus fletcheri* Ochs.**

Sta. 39. Rewa State, 3 miles from Koilari, 2,650 ft., II/1927. (H. S. Pruthi). 7 specimens.

Described from S. Malabar : Kollengode and collected moreover in Chota Nagpur : Chaibassa, Singhbhum dist., 2—3-iii-1913 (F. H. Gravely) and Chakradharpur, Sanjai river, 8—10-ii-1918 (N. Annandale & F. H. Gravely).

There is a certain difference between the typical specimens and those from Central India, chiefly in the males, in that the broadening of the tomentous border of elytra begins nearer the base in the typical specimens.

***Orectochilus ritsemai* Rég.**

Sta. 39. Rewa State, 3 miles from Koilari, 2,650 ft.; II/1927. (H. S. Pruthi). 22 specimens.

Sta. 82. Centr. Prov., at Mandla, XI/1927. (*id.*). 1 specimen.

Sta. 96. Centr. Prov., at Barham Kalan, current slow, XII/1927. (*id.*). 15 specimens.

Sta. 97. Centr. Prov., at Barham Kalan, current rapid, XII/1927. (*id.*). 1 specimen.

Sta. 101. Centr. Prov., at Sandia, XII/1927. (*id.*). 7 specimens.

This species was described from an old specimen labelled "Java"; this locality, however, seems doubtful. In my collection there is a specimen with the same provenance, which I found together with a specimen of the Indian species, *Orectochilus cylindricus* Rég., and I believe that the indication "Java," in both cases, is erroneous. *O. ritsemai* was collected recently in Burma : Mergui, I/1927 (Parker) and in Tonkin : Hoah Binh (de Cooman) and Hat-Lon-Man, 29-vii-1918 (V. de Salvaza).

***Orectochilus limbatus* Rég.**

Sta. 12. Rewa State, a big pool near Amarkantak, 3,300 ft., I/1927 (H. S. Pruthi). 2 specimens.

Sta. 36. Rewa State, near Koilari, 2,650 ft., II/1927. (*id.*). 1 specimen.

Sta. 49. Rewa State, a tributary, Kornu Nala, at Pongatola, 5 miles from Khetgaon, III/1927. (*id.*). 1 specimen.

Sta. 62. Centr. Prov., Mandla dist., Deo Nullah, a little below Sakka, 8-vi-1927. (B. N. Chopra). 27 specimens.

Sta. 63. Centr. Prov., Mandla dist., Kharmer Nullah, about a mile beyond Sakka, 9-vi-1927. (*id.*). 15 specimens.

Sta. 66. Centr. Prov., Mandla dist., Burhner river near Mohagaon, stones on the sides of the water channel, 16—17-xi-1927. (H. S. Pruthi). 2 specimens.

- Sta. 65. Centr. Prov., Mandla dist., Burhner river near Mohagaon, XI-1927. (*id.*). 16 specimens.
- Sta. 75. Centr. Prov., between Dupla and Gorakpur, XI/1927. (*id.*). 60 specimens.
- Sta. 82. Centr. Prov., at Mandla, XI/1927. (*id.*). 3 specimens.
- Centr. Prov., Mandla, 21—23-v-1927. (B. N. Chopra). 101 specimens.
- Sta. 84. Centr. Prov., Mandla, stones near the river channel, XI/1927 (H. S. Pruthi). 80 specimens.
- Sta. 87. Centr. Prov., at Padmi, XII/1927. (*id.*). 1 specimen.
- Sta. 101. Centr. Prov., at Sandia, XII/1927. (*id.*). 5 specimens.
- Khandesh, Nerbudda river, 19-v-1903. (R. T. Bell Coll., Brit. Mus.).
- Rewa State : Umaria, Rewa, Jaithari Range, 19-xi-1927 (Beeson).

This species was described by Régimbart from a single female specimen, labelled "Ind. or.", in the old collection of Wehncke, now incorporated in collection Oberthür. He later recorded it from Barway (R. P. Cardon) and Khandesh (R. T. Bell); from the latter locality I have seen some specimens as noted above.

Orectochilus gravelyi Ochs (1925, *Rec. Ind. Mus.* XXVII, p. 199) from Chota Nagpur is identical with *O. limbatus* Rég., as is clear on examination of the Khandesh specimens and as I was informed by Mr. Peschet of Paris, to whom I sent specimens of *O. gravelyi*, and who compared these with the specimens in the collection of Régimbart. The only difference he could state was that the tomentous border of elytra was more regularly and not convexly broadened posteriorly in Régimbart's specimens, and, indeed, among the large series from Chota Nagpur, Central India, and other localities which I have seen since there is a certain variation in respect to this character.

To the localities mentioned above and those cited in 1925 must be added : Chota Nagpur, Chakradharpur, Sanjai river, 8—10-ii-1918 (N. Annandale and F. H. Gravely); Bombay Pres., 2,250 ft., W. Ghats, Matheran, Charlotte Lake, 26-iii-1908 (G. B. Longstaff); Base of Nilgiris, the edge of Bhavani river, 10 miles from Mettupalayam, *ca.* 1,800 ft., 20-viii-1918 (N. Annandale); Ceylon (Lewis, Brit. Mus.).

From Chakradharpur, Sanjai river, 8—10-ii-1918 (N. A. & F. G.), there are some larvae which belong probably to the above species, to *O. fletcheri* or to *O. haemorrhous*, which were taken with it at that locality.

These larvae, 5 specimens in all, are 13, 13, 13, 11 and 8 mm. respectively in length. The body is relatively slender (about $1\frac{1}{4}$ mm. wide and 13 mm. long) and cylindrical, except the head, which is flattened dorso-ventrally. The head is subquadrate, about twice as long as wide, narrowed posteriorly in a short neck; it is wholly chitinous and somewhat darker than the less strongly chitinated parts of the body. The eyes, the lateral parts of the neck, two spots on the ventral surface near the mouth are black. The anteriorly almost straight and truncate clypeus confirms these as *Orectochilus* larvae. The usual six stemmata are broadly oval or nearly circular; of the three dorsal ones the middle lies nearest to the vertex, and of the three ventral ones, the two last are the smallest, and are arranged in the form of an irregular ellipse; the first ventral stemmata is situated slightly behind and below the first dorsal one. The palpi are relatively long and slender, compared to those of the larva of *Gyrinus natator* L., a single specimen of which I possess for comparison. The

prothorax is protected by chitinous plates dorsally and ventrally, and is naked only at the sides. The other segments of the body are not heavily chitinised and are paler in colour. There are only some small blackish marks at the base of each leg. All the lateral gills seem fringed with hairs.

Larvae of Indian Gyrinidae were described by Nowrojee (1912, *Mem. Dept. Agric. Ind.*, Ent. Ser. II, 9, p. 177, pl. xxvi, fig. 5, probably of *Dineutus* (*Gyrinodineutus*) *unidentatus* Aubé) and by Lesne (1902, *Bull. Soc. Ent. France*, p. 86, probably of *Dineutus* (*Protodineutus*) *indicus* Aubé). The chief distinctive characters seem to be the following :

A. All lateral gills fringed with hairs.

— The first pair of gills maned (body large and broad, clypeus 4-dentate) *D. indicus* (*Protodineutus*).

B. Prothorax not protected ventrally (body broad, flattened, clypeus ?) *D. unidentatus* (*Gyrinodineutus*).

— Prothorax protected ventrally (body slender, cylindrical, clypeus not dentate) *Orectochilus* sp.

***Orectochilus discifer* Walk.**

Sta. 7. Rewa State, the Sone river at Amarkantak, 3,300 ft., January, 1927 (H. S. Pruthi). 12 specimens.

Sta. 28. Centr. Prov., Satpura Hills, Pachmarhi (Gravelly). 3 specimens.

— Rewa State, Amarkantak, 3,500 ft., 21-xi-1927 (Beeson).

— Rewa State, Umaria Rewa, Jaithari Range, in stream, 21-xi-1927 (Bhatia).

Described from Ceylon, also occurring from South India to Central India : Travancore, Wallardi ; Cochin State, Forest Tramway from Parabikulam to Kavalai, 1,000-2,000 ft., 24-ix-1914 (F. H. Gravelly) ; S. Malabar, Dhoni Forest, 1,500-4,000 ft., 15-26-v-1923 (E. Barnes) ; Tenmalai, Courtallum, 28-x-1926 (H. S. Rao) ; Nilgiris, torrential stream below Benhope Bungalow, 21-x-1925 (S. L. Hora) ; Madras, Nilambur, in stream, 25-v-1927 (S. N. Chatterjee) ; Bombay Pres., Poona dist., Khandala, ca. 2,500 ft., 6-10-iii-1918 (Annandale) ; Bombay Pres., Khandala, from pools in rocky stream VII/1919 (R.B.S. Sewell). The localities of specimens labelled " Bengal " and " Calcutta " in my collection are doubtful and so are the specimens from Malacca referred to this species by Régimbart.

***Orectochilus productus* Rég.**

Sta. 12. Rewa State, a big pool close to Amarkantak, 3,300 ft., I/1927 (H. S. Pruthi). 1 specimen.

Sta. 75. Centr. Prov., the river between Dupla and Gorakpur, 1,500 ft., XI/1927 (*id.*). 1 specimen.

— Centr. Prov., Mandla dist., Dindori, 6-vi-1927 (B. N. Chopra). 1 specimen.

— Rewa State : Umaria, Rewa, Jaithari Range, 19-xi-1927 (Beeson). 1 specimen.

This is a widely distributed species, ranging from South India to Eastern Himalayas and Assam, Burma, Malay Peninsula, Siam, Cambodia, Tonkin, Annam and Borneo. It is said to occur also in S. China. Indian localities are : Cochin State, Chalakudi 14-30-ix-1914 (Gravelly) ; Travancore, Kerumaadi, S. end of Vembanaad Lake, 6-xi-1908

(Annandale); Madras X/1921 (H. C.); Chota Nagpur, Manbhum (Hallowes); Bihar, Pusa 2-iv-1912 (Fletcher) 27-xii-1904 (P. C. P.), Bankipur, 25-x-1911 (Fletcher); Bengal, Calcutta, Garia, 13-xii-1910 (Kemp), Konbir, Sunderbunds; Base of E. Himalayas, Siliguri 3—4-vi-1911 (N. A. & S. K.); Garo Hills, Damalgiri, Ganool river, VIII/1917 (S. Kemp); Assam, Mangaldai, Central Tank, 6-i-1911 and Seali Kusi 8-i-1911 (Kemp); N.E. Assam, Dibrugarh (Abor Exp., 17—19-xi-1911 (Kemp); Burma, Bassein (Schmidt), Rangoon 26-ii-1908, 10-i-1927, in paddy pool (F. J. Meggitt), 29-i-1927 (*id.*), 14-xii-1927 (T. D. A. Cockerell); Lower Burma, Amherst dist., Kawkareit, 19—20-xi-1911 and outside Farm Caves near Moulmein, 17-xi—4-xii-1911 (Gravely).

Orectochilus indicus Rég.

Sta. 96. Centr. Prov., the river at Barham Kalan, current slow, XII/1927 (H. S. Pruthi). 1 specimen.

Hitherto known from Ceylon and from Bangalore, alt. *ca.* 3000 ft., 13-x-1910 (Annandale) and Chikkangalur (Tabourel). Régimbart's records from Bengal seem doubtful.

GENERAL REMARKS.

The large collection, details of which are given above, represents probably very completely the Gyrinid fauna of Central India. It comprises 10 species, 3 of which, *viz.*, *G. convexiusculus*, *D. indicus* and *O. discifer* seem to frequent the higher altitudes (3,300-3,500 ft.), where the other species are either entirely absent or are found in very small numbers, and even these may have got there by accident. On the other hand, these 3 species are almost completely wanting at altitudes below 3,000 ft., where *O. haemorrhous*, *O. fletcheri*, *O. ritsemai* and *O. limbatus* predominate. *D. unidentatus* and *O. productus*, which are represented by single specimens, belong apparently to a fauna which is generally confined to still lower altitudes; and a certain difference in the faunas of areas of different altitudes seems to be indicated by the distribution of the different species in Central India. *O. indicus* belongs to a group the representatives of which have been rarely collected and which probably have a restricted distribution.

None of the above 10 species is endemic in Central India, and it is clear, in view of the central situation of the area in question, that a mixed fauna must be found there. *O. limbatus* Rég. is probably the characteristic species of Central India, as it has been collected there very frequently, and though its range extends to South India and Ceylon, it is rather rare in those parts.

There are several indications of a relationship between the Gyrinid fauna of Central India and that of South India, but several characteristic species of the latter region (especially *Aulonogyrus obliquus* Walk. and *Orectochilus semivestitus* Guer.) are wanting in Central India. There are nevertheless important differences between the two faunas. The difference between the Gyrinid fauna of Central India and that of the Himalayas and even that of the Gangetic Plain, with which it is the most contiguous, are still more marked, as the representatives of the genus

Orectochilus known from these areas are very different and only exceptionally we find species common to these regions.

The following table (pp. 248, 249) illustrates the distribution of the Indian species of Gyrinidae over the different faunal districts. It shows a great decrease in the numbers of species at lower altitudes, as for instance in the Gangetic Plain, which is correlated with the fact that certain species and especially most of the *Orectochili* are apparently found in rapid-running waters which are only found at high altitudes. In the plains and near the coast round the Gulf of Bengal we find only two species, viz. *D. spinosus*, Fab.¹ and *O. productus*, Rég., which seem to be characteristic for these areas.

On comparing the Gyrinid fauna of different areas one finds that Ceylon has a comparatively richer fauna and that it comprises a large number of endemic species; this is probably due to the mountainous character of the country and insular isolation. It may also be attributed to the circumstance that in pre-historic times Ceylon formed a part of an extensive continent or land-bridge running in the east to Malaysia and probably including in it the Andaman Islands. Most of the relationships between the faunas of Ceylon, South India and Central India on the one hand, and those of Malaysia and Burma on the other, may, therefore, be explained as being due to a migration in the eastern direction over this land-bridge rather by the direct route *via* Bengal to Central India; this is also confirmed by the decrease in the number of the species from South India to Central India. The fauna of South India is closely allied to that of Ceylon, but it contains a large number of endemic species; in Central India also we find the same species, though in much smaller numbers. The Gangetic Plain forms a distinct barrier against the interchange of the faunas of these southern provinces on the one hand, and those of the Himalayas in the north and of the Eastern provinces (Assam and Burma) in the east on the other. The almost complete absence of Gyrinidae in the Western provinces is perhaps due to insufficient field work, or may be attributed to the arid character of these parts. In Kashmir Palaeartic species are the common forms. The Himalayan fauna shows many relations to that of Assam and Burma, but the Gyrinid fauna of the Western Himalayas is slightly different from that of the Eastern. Several Himalayan species, however, which apparently do not occur in Assam and Burma, are found in Upper Tonkin. We are not fully acquainted with the Gyrinid fauna of Assam, but it comprises, so far as is known, several Himalayan and Burmese elements, though most of these forms occur as distinct varieties; there

¹ *D. spinosus*, Fab. is generally confined in India to low altitudes. A very striking varietal form of it, which I describe below, was, however, collected in Nepal.

D. spinosus Fab. subsp. *nepalensis*, nov.

A little larger than the typical form, especially the male, which is mostly larger in size than the female, unlike what is the rule in the typical form. The specimens of the new subspecies are more broadly oval and the spinal terminations of their elytra are shorter, thus resembling very greatly *D. orientalis* Mod. (= *marginatus* Sharp), which is, however, easily distinguished in the female sex by the second (visible) sternite being produced in the middle of its posterior margin as a large lobe covering the two following sternites. This is a very peculiar character, which has not been noticed so far.

Holotype from Nepal Valley, Soondrijal, X/1906 (*R. Hodgart*) in the Indian Museum; many paratypes in the Indian Museum and in my collection.

are further many endemic species representing the peculiar characteristics of this interesting faunal area. The number of species known from Burma is very large, but endemics are not very numerous. The Burmese fauna shows a close relationship with that of Tonkin, the Malay Peninsula and the Sunda Islands, but the species of these areas are generally very widely distributed.

| | Ceylon. | South-India. | Central India. | Valley of the Ganges. | Kashmir. | Western Provinces. | West. Himalayas. (East.) | | Assam. | Burma. | Andaman Islands. |
|-----------------------------------|---------|--------------|----------------|-----------------------|----------|--------------------|-----------------------------|---|--------|--------|------------------|
| <i>Aulonogyrus</i> — | | | | | | | | | | | |
| <i>obliquus</i> . . . | + | + | | | | | | | | | |
| <i>Paragyrrinus</i> — | | | | | | | | | | | |
| <i>arrowi</i> . . . | | | | | | | + | + | + | | |
| <i>Gyrinus</i> — | | | | | | | | | | | |
| <i>ceylonicus</i> . . . | * | | | | | | | | | | |
| <i>convexusculus</i> . . . | + | + | + | ? | | | | + | | + TM | |
| <i>distinctus</i> . . . | | | | | + | | | | | | |
| <i>smaragdinus</i> . . . | | | | | (pal.) | | | | + | + T | |
| <i>Dineutus</i> — | | | | | | | | | | | |
| (<i>Gyrinodineutus</i>) | | | | | | | | | | | |
| <i>unidentatus</i> . . . | + | + | + | + | | ? | | | | ? TM | |
| <i>spinosus</i> . . . | ? | + | | + | | | + | + | + | + M | |
| subsp. <i>nepalensis</i> . . . | | | | | | | | + | | | |
| (<i>Protodineutus</i>) | | | | | | | | | | | |
| <i>indicans</i> . . . | + | + | + | ? | ? | + | + | + | ? | | |
| (<i>Porrhynchus</i>) | | | | | | | | | | | |
| <i>indicans</i> . . . | * | | | | | | | | | | |
| <i>marginatus</i> . . . | | | | | | | | | | + TM | |
| <i>Orectochilus</i> — | | | | | | | | | | | |
| <i>aeneipennis</i> . . . | | * | | | | | | | | | |
| <i>andamanarum</i> . . . | | | | | | | | | | | * |
| <i>andamanicus</i> . . . | | | | ? | | | | | | + | + |
| ? <i>angusticinctus</i> . . . | | | | | | | | | | + T | |
| <i>annandalei</i> . . . | | * | | | | | | | | | |
| <i>apicalis</i> . . . | | | | | | | | | | + T | |
| <i>birmanicus</i> . . . | | | | | | | | | | + T | |
| <i>cameroni</i> . . . | | | | | | | * | | | | |
| sp. dist. ? . . . | | | | | | + | | | | | |
| <i>cardoni</i> . . . | | + | + | | | | | | | | |
| <i>cardiophorus</i> . . . | | | | | | | | | | * | |
| subsp. <i>peguensis</i> . . . | | | | | | | | | | + | |
| <i>castetsi</i> . . . | | * | | | | | | | | | |
| <i>cavernicola</i> . . . | | | | | | | | | * | | |
| <i>ceylonicus</i> . . . | * | ? | | | | | | | | | |
| <i>choprai</i> . . . | | | | | | | | | * | | |
| sp. dist. ? . . . | | | | | | | | | + | | |
| <i>coimbatorensis</i> . . . | | * | | | | | | | | | |
| <i>cordatus</i> . . . | | | | | | | | | | + T | |
| <i>coronatus</i> . . . | | | | | | | | | * | | |
| <i>corpulentus</i> . . . | | | | | | | | | | * | |
| <i>cribratellus</i> . . . | | | | | | | | | | + | |
| subsp. <i>metallescoens</i> . . . | | | | | | | | + | | | |
| subsp. ? . . . | | | | | | | | | + | | |

= endemic species.

T = occurs also in Tonkin.

M = occurs also in the Malay Peninsula or in the Sunda Islands.

| | Ceylon. | South-India. | Central India. | Valley of the Ganges. | Kashmir. | Western Provinces. | Himalaya. | | Assam. | Burma. | Andaman Islands. |
|--|-------------------|-------------------|----------------|-----------------------|----------|--------------------|-------------------|---------|-------------------|-------------------|------------------|
| | | | | | | | West. | East. | | | |
| <i>Orectochilus</i> —contd. | | | | | | | | | | | |
| <i>cuneatus</i> | | | | | | | + | + | | | |
| <i>cylindricus</i> | | | | * | | | | | | | |
| <i>desgodinsi</i> | | | | | | | | + | | | |
| subsp. <i>assamensis</i> | | | | | | | | | + | | |
| <i>dilatatus</i> | | ? | | | | | | | | | |
| <i>discifer</i> | + | + | + | ? | | | | | | | |
| <i>fairmairei</i> | * | | | | | | | | | | |
| <i>figuratus</i> | | | | | | | ? | + | | | |
| sp. dist. ? | | | | | | | | + | | | |
| <i>fletcheri</i> | | + | + | | | | | | | | |
| <i>fraternus</i> | * | | | | | | | | | | |
| <i>gangeticus</i> | | | | + | | | | + | | | |
| <i>haemorrhous</i> | | + | + | + | | | | + | | | |
| <i>indicus</i> | + | + | + | ? | | | | | | | |
| <i>intermedius</i> | | | | | | | | | | * | |
| <i>kempi</i> | | | | | | | | | * | | |
| <i>limbatus</i> | + | + | + | | | | | | | | |
| ? <i>lucidus</i> | | | | | | | | | | + | |
| <i>marginipennis</i> | | | | | | | | | | + | |
| subsp. <i>angustilimbus</i> | | | | | | | + | | | | |
| " ? | | | | | | | | | + | | |
| <i>metallicus</i> | | | | | | | + | +T | | | |
| <i>murinus</i> | | | | | | | + | +T | | | |
| <i>neglectus</i> | | | | | | | * | | | | |
| sp. dist. ? | | | | | | | | + | | | |
| <i>oblongiusculus</i> | | | | | | | ? | +T | | | |
| subsp. <i>feai</i> | | | | | | | | | | + | |
| " ? | | | | | | | | | + | | |
| " <i>parkeri</i> | | | | | | | + | | | | |
| <i>productus</i> | + | + | + | + | | | | + | + | +TM | |
| ? <i>punctilabris</i> | | | | | | | | | | +TM | |
| <i>punctulatus</i> | | * | | | | | | | | | |
| <i>ritsemai</i> | | | + | | | | | | | +T | |
| ? <i>rivularis</i> | | | | | | | | | +T | | |
| <i>scalaris</i> subsp. <i>parvulus</i> | | * | | | | | | | | + | |
| <i>semivestitus</i> | | | | | | | | | | | |
| <i>similis</i> | | | | | | | | | * | | |
| <i>sublineatus</i> | | | | | | | | | ?T | | |
| <i>sulcipennis</i> | | | | | | | | | | +T | |
| <i>tomentosus</i> | | | | | | | | | | * | |
| <i>trianguliger</i> | | | | | | | | | | * | |
| <i>villosovittatus</i> | | | | | | | | | | +T | |
| <i>volubilis</i> | | | | | | | | | * | | |
| <i>wehnckeii</i> | * | | | | | | | | | | |
| | 15 1? (7 *) | 18 2? (6 *) | 11 — | 6 5? (1) | 1 1? | 1 1? | 11 2? (2 *) | 17 — | 16 2? (6 *) | 25 1? (5 *) | 2 — (1 *) |

* = endemic species.

T = occurs also in Tonkin.

M = occurs also in the Malay Peninsula or in the Sunda Islands.

DESCRIPTIONS OF TWO NEW GYRINIDAE FROM ASSAM.

By GEORG OCHS, *Frankfurt a/Main.*

Two new species from Assam, the descriptions of which are given below, were discovered in a large collection of Gyrinidae from the Indian Museum, Calcutta, which, through the kindness of Dr. Hem Singh Pruthi, Assistant Superintendent, Zoological Survey of India, was placed in my hands for study.

Orectochilus similis, sp. nov.

Long 11 mm. Elongato-ovalis, antice et postice attenuatus, modice convexus. Supra niger, nitidus, in regionibus glabris fortiter punctulatus et leviter reticulatus, punctis majoribus vix conspicuis, ad latera punctato-tomentosus, pubescentia lutea, rufo-marginatus. Infra niger, pedibus rufis, anticis obscurioribus, epipleuris dilutioribus. Labro semicirculari, porrecto, supra in medio glabro, caeterum punctato-piloso, margine antico flavo-ciliato. Margine tomentoso in pronoto sat lato, post oculos latiore, in elytris angusto, ad humeros breviter triangulariter dilatato, ad apicem leviter et regulariter dilatato et margine angusto juxta truncaturam suturam paulo ante apicem attingente. Spatio communi laevi elytrorum postea late ovali, lineis longitudinalibus vix praebentibus; truncatura convexa, extus sinuata, angulo suturali fere recto rotundato, externo producto spinoso. Tibiis anticis triangularibus, sat robustis, margine interno dilatatis, ad basin attenuatis, antice oblique truncatis; angulo apicali externo obtuso, haud deleto. Tarso brevi, late ovali, antice attenuato.

Habit.—Assam, Shillong, 4,500-5,000 ft., 16—20-iv-1918 (*N. Anandale*).

Holotype and paratype in the Indian Museum.

Closely allied to *O. sublineatus* Rég., but a little larger in size, more elongate, and more attenuated anteriorly. The labrum is more strongly produced. The longitudinal striae and the large punctures, which are distinct in *O. sublineatus*, are almost inconspicuous in *O. similis*. The exterior apical angle of the elytra is strongly produced; the tomentous border of elytra is only slightly dilated posteriorly and the inner margin is regularly concave, while the hairless dorsal part is broadly oval posteriorly. The aedeagus is much narrower and the tip is more strongly curved than in *O. sublineatus*.

The above comparison is based on specimens of *O. sublineatus* from Laos, Annam, Indo-China, which locality must be taken as typical for this species. Régimbart also recorded *O. sublineatus* from Assam, but I believe that this record is to be referred to the species described above.

O. birmanicus Rég. is similar to *O. similis* in regard to the sculpture of the elytra, but is smaller than the latter, has the labrum and the outer apical angle of elytra less produced, and the tomentous border of the elytra much more dilated posteriorly.

Orectochilus volubilis, sp. nov.

Long $9\frac{1}{2}$ mm. Ovalis, haud elongatus, antice et postice parum attenuatus; parum convexus. Supra niger, nitidissimus, ad latera punctato-tomentosus, pubescentia grisea, flavo-marginatus; infra niger ano pedibusque rufis, epipleuris flavis. Labro semi-circulari, supra punctato-piloso, margine antico flavo-ciliato. Clypeo fortiter reticulato, areolis rotundatis, et remote punctato; capite, pronoto et elytris in regionibus glabris vix visibiliter transversim reticulatis punctisque tenuissimis remotis instructis, sculptura in capite ante oculos et in elytris apicem versus magis conspicua. Margine tomentoso in pronoto sat lato, post oculos valde intus dilatato; in elytris angusto, ad humeros breviter triangulariter dilatato, postea regulariter dilatato et truncaturam circiter ad medium attingente. Truncatura elytrorum leviter obliqua, angulo suturali rotundato, externo producto, spinoso. Tibiis anticis in ♂ triangularibus, sat latis, antice recte truncatis, angulo apicali externo recto haud deleto tarsis dilatatis, ovalibus, antice attenuatis; in ♀ tibiis minus latis, fere subparallelis, tarsis haud dilatatis, parallelis.

Habitat.—Assam, Shillong, 4 500-5 000 ft., 16—20-iv-1918 (N. Annandale).

Holotype and allotype in the Indian Museum.

This species is intermediate between the groups of *O. spiniger* Rég. and of *O. birmanicus* Rég. It resembles the former in the sculpture of the surface, the shape of the labrum and the strongly produced apical angle of the elytra. It is, however, much broader and less elongate than the species of *O. spiniger* group, and in its general appearance resembles *O. birmanicus* and its allies. From this latter group of species it is, however, easily distinguished by the poorly developed sculpture on the surface, the outline of the tomentous border of the elytra, which do not reach the suture, and by the spine-like apical angles of the elytra.

The aedeagus is $\frac{3}{4}$ as long as the lateral lobes; it is broad at the base, gradually narrowing to the apex, which is truncate and slightly emarginate in the middle. This may, however, be due to mutilation, as the tip is broken.

ON THE IMMATURE STAGES OF AN INDIAN SPECIES OF *HELICHUS* (DRYOPIDAE : COLEOPTERA).

By HEM SINGH PRUTHI, *Zoological Survey of India, Calcutta.*

(Plate XI).

INTRODUCTORY.

There is a great deal of difference of opinion with regard to the affinities of the families Dryopidae, Elmidae and Psephenidae of the superfamily Dryopidea. Studies of the adults of these families not having proved very useful in this connection, entomologists are now rightly looking to the structure of the immature stages of these beetles for clearing up their relationships. Böving (1) has recently studied *Psephenoides gahni* (Dryopidae) from this point of view. *Psephenoides*, as is evident from Böving's account, is specialized in several ways, hence to have a fairly comprehensive view of the family it is highly desirable that some simple genera like *Helichus*, etc., should be studied. Since 1883, when Kellicott (8) incidently figured the larva of *Helichus lithophilus*, hardly anything has been published on the younger stages of this genus. During 1927, while surveying the fauna of the Nerbudda river, I collected a large number of larvae of a species of *Helichus*¹ and made observations on their bionomics. The larvae were brought alive to Calcutta, where they lived in the laboratory for about six months, when suddenly they began dying. In the meantime, however, a few had pupated, but unfortunately none reached the adult state; fully formed pupae were also found inside the larval skins of some of the dead larvae. It, therefore, appears highly probable that the sudden death of the larvae was due to their not being able to metamorphose properly under laboratory conditions.

Habitat and habits of the larvae.

The larvae were obtained for the first time in the Nerbudda near the village Koilari, about 45 miles from its source. They were not common at this place as only two specimens were obtained after four hours search. Two more specimens were collected near Khetgaon, about 8 miles further down the river. The larvae were, however, very common in the headwaters of the Dholbaja *nala* which falls into the Nerbudda River at a distance of about 10 miles from Khetgaon. The collection was mostly made in this *nala* near the village Bondor. At the time of collection (February, 1927) this stream was about a foot deep and five feet wide. Its bed was sandy, with numerous stones lying in the water channel. There was hardly any phanerogamic growth near

¹ The material was sent for naming to Dr. A. D. Böving of U. S. National Museum, but he, owing to the absence of any good account of the immature stages of this genus, expressed his inability to refer the larvae to any species.

the stream. The current was rather slow, and the pH of the water was 8.45 (not corrected for salt error). Many larvae were also collected from several pools near the banks, the water of which was almost muddy. Both young and full-grown specimens were living together. They were mostly found in crevices on the under-surface of stones and could be easily dislodged therefrom. When the stones were turned upside down, the larvae crept over to the side away from the light.

The larva is very sluggish; it seldom moves and even then very slowly. In its resting position, its head is retracted under the prothorax and the legs are bent, the margins of the body being in close contact with the substratum. The larva can crawl along a smooth surface such as that of glass but it cannot climb up the sides of a glass vessel.

As is described hereafter, the larvae are provided with anal gills which are thrust out and exposed to water in the act of respiration. If a larva is disturbed, it retracts the gills, bends its legs and lies motionless, almost flush with the substratum. Some individuals were continuously disturbed with a view to ascertaining the period for which they could keep their gills retracted. It was observed that they could do so for about 25 minutes, at the end of which period the gills were protruded in spite of any disturbance. When taken out of water, the larvae do not live for more than half an hour.

Morphology.

a. Larva.

The larva (fig. 1) differs considerably from the larvae of most of the allied genera, e.g. *Psephenoides*, *Psephenus*, etc. It is elongate-elyptical, narrowed posteriorly, and almost scale-like in appearance. The dorsal surface is convex, hard and horny, while the ventral side is flat and soft. The body segments are extended on either side and bear long hairs on their lateral margins. The extensions of the various body segments are more and more directed backwards as one goes from the anterior to the posterior end; those of the eighth abdominal segment being almost parallel to the middle line of the body. The pronotum does not only extend laterally but anteriorly as well, and forms a shield-like structure over the head. The lateral extensions, unlike those in the above named allied genera, are not at all fused with one another, consequently the body of the larva cannot closely adhere to the substratum. This explains why the larvae are not met with in rapid running waters.

A full-grown larva is about 0.60 cm. in length and 0.22 cm. across the thorax. Its dorsal surface is ochraceous, but under a powerful lens seems to be covered all over with minute black dots. In addition, there are numerous dark patches and blotches; those on the first six abdominal segments being more prominent. The ventral surface is pale, with an orange-coloured patch in the region of the first three abdominal segments.

The head (fig. 1) is very small, but quite heavily chitinized. Ordinarily it remains retracted, under the large pronotum, into a pocket formed by the invagination of the soft and large prosternum. The neck is very long, but is devoid of any sclerite.

The antennae (fig. 2) are three-jointed, with a large basal piece (*bp*). The first joint is short and stout and bears numerous stiff setae at its distal extremity. The second joint is the largest of the three and is fairly thick. The third joint is very minute and is not provided with the terminal bristle which is usually found in other genera of this family. It is hardly distinguishable from the seta (*s*) at the apex of the second antennal joint.

The mandibles (fig. 3) are large, sub-triangular, and without any teeth. Their tips are more or less blunt and strongly chitinized; they protrude out of the mouth.

The maxillae (fig. 4) are long, flattened, slipper-shaped, with small cardo (*c*) and well developed stipes (*st*). The latter bears numerous setae, of which the one near the anterior outer corner is very long. The galea (*g*) and lacinia (*l*) are distinct and provided with numerous marginal setae and hairs. The maxillary palpi (*mcp*) are fairly long and three-jointed; their terminal joint has a pair of minute setae at the apex.

The labium (fig. 5) is very large, and bears numerous branched and unbranched bristles in its distal region. The sub-mentum (*sm*) is more or less semi-circular in outline and is separated from the rest of the labium by a fine transverse suture. The mentum (*m*) is fairly large. The palpiger (*plg*) is very distinct, and the palp (*lbp*) is two-jointed. The distal margin of the ligula (*li*) is covered with dense fine hairs. The hypopharynx (*hyp*) is a fork-shaped structure, lying longitudinally in the middle of the labium; under high power it appears to be made up of minute tubercles.

The prothorax (fig. 1) is very large. The meso- and metathorax, which are fairly well developed, are hardly fused with each other. The thoracic sterna are distinct and broad and the legs of one side are, therefore, widely separated from those of the other. The legs are well developed, and the coxae (*cox*) are fairly large, conical and thick.

The first eight abdominal segments (fig. 1, 1-8) are almost similar to one another except in point of size. The ninth segment (9) is large and rectangular, and its sternal region is quite distinct from the lateral pieces. The tenth segment is small and very thinly chitinized. It surrounds the terminal part of the rectum and is hardly visible.

The larvæ breathe by means of a pair of protrusible rectal gills (fig. 6). Each gill consists of a long filament from the base of which numerous fine branches originate which are almost as long as the filament itself. When the gills are protruded they appear as three tassel-like tufts. In *Psephenoides*, according to Böving, there are also two branchiae. But in *Elmis* (Elmidae), according to Fowler (4) and Lefroy (5), there are three branchiae. It is highly probable that in *Elmis* also there are only two branchiae which appear three when protruded.

b. Pupa.

The pupa (fig. 7) is shorter and broader than the larva, being 0.50 cm. long and 0.25 cm. across the thorax. Unlike that in the allied genera, *Psephenoides*, etc., it is not fixed to the substratum. Its body is deeply curved, the ventral side being concave. The head and thorax are thick and broad, while the abdomen is narrow and compressed. The eyes

(e) are very prominent. The thorax, both above and below, and the ventral surface of the abdomen are pale ochraceous, while the dorsal surface of the abdomen is grey. There is a pair of crescent-shaped dark marks on each thoracic and abdominal notum. The antennal sheaths (*as*) are long and thick. All the appendages of the head and thorax are distinct and free from the body. Unlike that of the larva, the thorax of the pupa lacks the lateral extensions, but its abdomen is provided with extensions which, however, are quite different from those of the larva. Each abdominal extension is conical, bearing strong marginal hairs, and the vertex of the cone is produced into a long narrow process. On the dorsal side of each extension there is a club-shaped appendage (*ap*), those on the 6th abdominal segment being especially conspicuous. These appendages do not seem to have been described in any other member of this family. The gills are absent. The ninth abdominal segment is more or less retracted into the preceding body segments. The external genitalia (*gen*) are well developed.

Remarks.

The *Helichus* larva described above resembles the larva of *Psephenoides* in the form and size of the head and thorax, but in the general shape of the body, the nature of the lateral extensions, etc., it comes closer to the larva of *Elmis* (Elmidae), as described by Chapuis and Candeze (2), and to that of *Limnius* which I have been able to examine through the courtesy of Dr. A. D. Böving. The *Helichus* pupa also differs considerably from that of *Psephenoides*.

The larvae of *Helichus*, *Psephenoides* and *Elmis* have rectal branchiae and in this respect differ from those of *Psephenus*, *Eubrianax*, etc., which have a series of gills on the underside of the abdomen, therefore the arrangement of placing these latter genera in a family quite distinct from those including the former seems to be quite justified. It may, however, be pointed out that the larvae of *Psephenoides* and *Psephenus*, belonging to the two different groups defined above, are almost identical in the general form of the body; but this may be due to their similar habitats, namely, rapid running waters.

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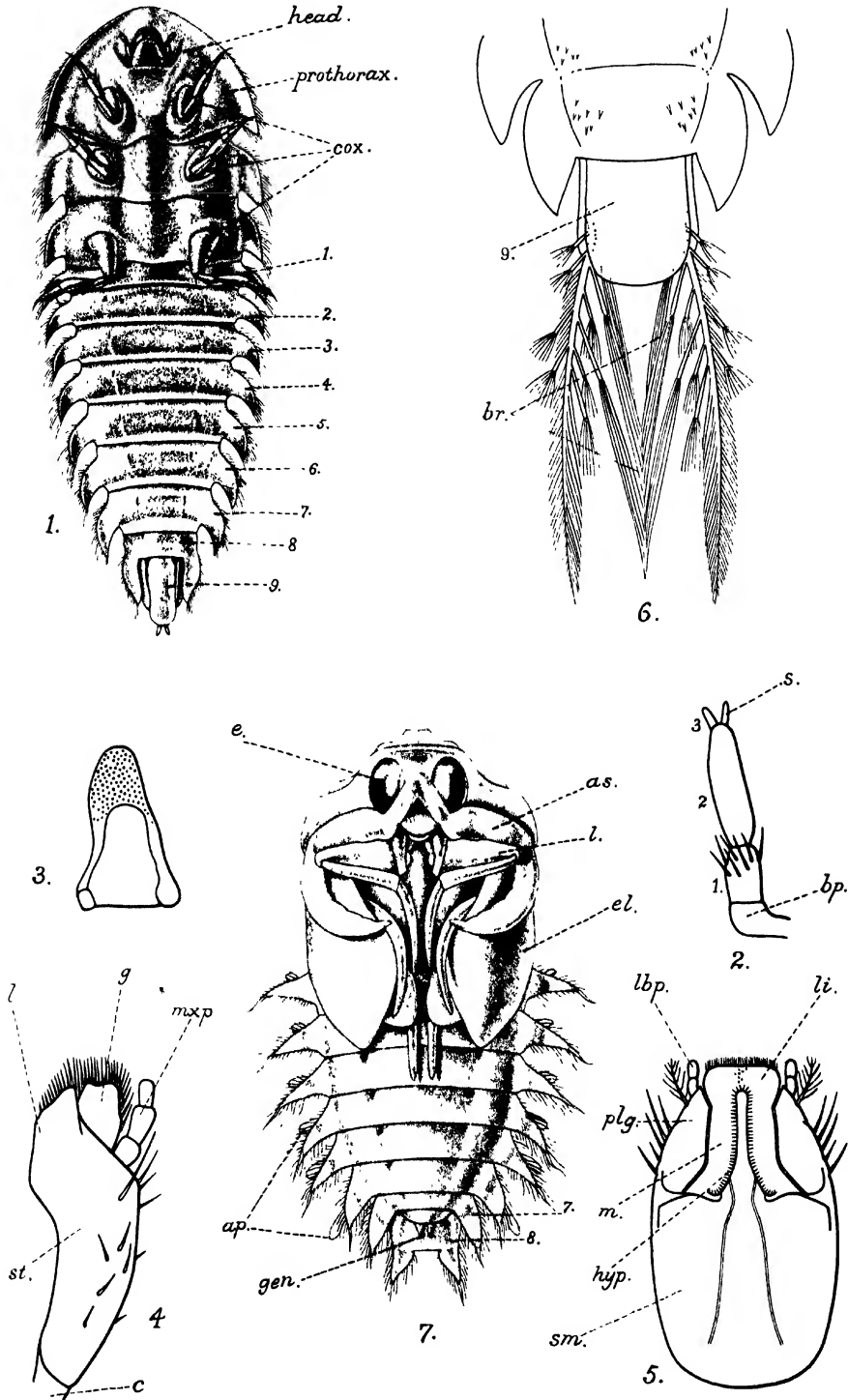
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EXPLANATION OF PLATE XI.

Helichus sp.

- FIG. 1.—Full grown larva ; ventral view, $\times 15$. *cox.* = coxae of legs. 1—9 = 1st to ninth abdominal segments.
- FIG. 2.—Antenna. *bp.* = basal piece ; *s.* = seta at the distal extremity of the 2nd antennal joint.
- FIG. 3.—Mandible.
- FIG. 4.—Maxilla. *c.* = cardo ; *st.* = stipes ; *l.* = lacinia ; *g.* = galea ; *mxp.* = maxillary palp.
- FIG. 5.—Labium. *sm.* = submentum ; *m.* = mentum ; *hyp.* = hypopharynx ; *plg.* = palpiger ; *lbp.* = labial palp ; *li.* = ligula.
- FIG. 6.—The posterior abdominal segments of the larva with the gills protruding out.
- FIG. 7.—Pupa ; ventral view. *e.* = eyes ; *as.* = antennal sheaths ; *l.* = legs ; *el.* = elytra ; *ap.* = the dorsal appendages ; 7—9 = the seventh to ninth abdominal segments ; *gen.* = external genitalia.



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HELICHUS sp.

ON A NEW SPECIES OF THE GENUS *THALASSEMA* FROM BOMBAY.

By B. PRASHAD, D.Sc., F.R.S.E., F.A.S.B., F.L.S., F.Z.S., Officiating Director, Zoological Survey of India, Indian Museum, Calcutta, and P. R. AWATI, B.A. (Cantab.), Professor of Zoology, The Royal Institute of Science, Bombay.

(Plate XII.)

In this paper we give the description of a new species of the genus *Thalassema* Lamarck which is fairly common in the intertidal zone in certain areas near Bombay and discuss its relationship with the other known Indian species.

***Thalassema bombayensis*, sp. nov.**

The shape of the body is variable, in a well preserved specimen, such as is figured on plate xii, fig. 1, it is elongate, cylindrical, gradually tapering posteriorly to a subtruncate tip and rounded anteriorly to where the proboscis is attached. The length of the body in the holotype preserved in 90 per cent. alcohol after fixation in formalin is 10.8 cm., but other specimens, depending on the state of preservation, vary from 7 to 12 cm. in length. The maximum breadth of the body is 2.5 cm. The proboscis, like the body, is capable of a great deal of contraction and expansion; in a well preserved specimen, such as the one selected as the holotype, it is elongated, somewhat tubular and is broadly truncated at its free anterior end; it is 2.4 cm. long, and its maximum breadth is .9 cm.; its form in a contracted condition is shown in the specimen illustrated in fig. 2. The ventral margins of the proboscis are free from one another almost to the point of attachment to the body, and unlike the condition in most of the estuarine Asiatic species of the genus, the margins are not united ventrally at the base to form a tube. The entire surface of the body is covered over by papillae, those in the middle region are minute (fig. 5, *p*), conical and hardly visible to the naked eye; along the two ends, however, there are a large number of fairly large somewhat raised ovoidal tubercle-like structures (fig. 6, *p'*) interspersed with the microscopic papillae of the same type as are found in the middle region of the body. Some large papillae (fig. 5, *p'*) are also to be seen in the middle region of the body. The tubercles, as is clear on examination with a lens, are formed by the union of groups of 4-5 small papillae. The arrangement of the papillae and tubercles is irregular over the greater part of the body but near the two ends they appear to be arranged in regular rings. The surface of the proboscis is quite smooth.

At a distance of about a centimetre from the anterior end in the mid-ventral line there are the usual two-hooked setae of a golden-yellow colour. Lying slightly externally to the hooks are the narrow, somewhat slit-like openings of the segmental organs. In a well preserved specimen two pairs of these openings were clearly visible anterior to

the hooks and 3 on the right and 2 on the left side posterior to the hooks ; in other specimens the openings could not be clearly distinguished. The longitudinal muscular layer of the body-wall is not continuous, but in the middle region of the body it is broken up into bundles. Normally the number of bundles is 10, and these are separated by interspaces almost as broad as the bundles themselves, but in some specimens one or another of the bundles is divided into two distinct bundles and as a result 11 bundles are present. Along the ends of the body, however, the longitudinal muscles form a continuous sheath. The number of segmental organs (fig. 3, *s.o.*) is variable, usually there are 5 pairs, 2 pairs lying anterior to and 3 posterior to the setal hooks, but in some specimens only 4 pairs of well developed segmental organs were found ; of the posteriormost fifth pair a vestigial one was developed on the right or left side and the corresponding organ of the opposite side was altogether absent (fig. 3). In one specimen there was no trace of the fifth pair. The vesicles of the segmental organs are drawn out into almost whip-like structures at their free ends, while the lateral margins of the funnels are provided with very long spirally-coiled lobes. The spiral lobes are only the lateral prolongations of the margins of the funnel, and are in normal specimens only two in number, but in one case the spiral structures by irregular dichotomous branching had developed into a bunch-like structure (fig. 4). The anal vesicles, which are greatly elongated structures, are of almost the same length as the body of the animal ; from a little in front of the middle they narrow gradually to almost thread-like structures ; the funnels are arranged irregularly on the anterior one-third of their length. No caecum could be distinguished in the specimens dissected by us.

The colour of the specimens preserved in formalin is light salmon-red, but owing to the blackish mud shining through the interspaces between the muscle bands these areas appear to be rather darker in colour.

Locality.—As is noted in the introduction the species has been found only in certain areas near Bombay in the intertidal zone of the beaches, specially at Chowpatty, Worli and Colaba. So far as is known the species is not widely distributed all along the coast. The bottom in the intertidal areas at these places consists of a blackish sandy mud.

Holotype.—No. $w\frac{1525}{1}$ in the collections of the Zoological Survey of India (Indian Museum), Calcutta.

Remarks.—This animal is gregarious and is found in colonies living in muddy ooze containing a large quantity of fine sand grains ; each animal occupies a separate burrow in the colony. The burrows are easily recognised by the presence of small elliptical pellets of excreta lying in the depressions of the burrows. The number of individuals in the colonies is very large, as many as forty specimens were found on one occasion in a single colony.

The animal is very slippery owing to the presence of large quantities of mucus all over the body and especially on its posterior part.

It is found all the year round, and its breeding season is from July to September, though sometimes specimens with ripe ova and sperms are found as late as October and November.

There are no external sexual differences, but in the breeding season males can generally be recognized from the females. In the males the segmental organs, which are distended with ripe sperms, are seen through the more or less transparent skin as shining milky-white structures; while in the female these organs containing the ripe ova are dull grey. In some cases the males are bright red, while the females are usually of a dull colour.

Relationships.—Leaving out of consideration the species ¹ of the genus *Thalassema* Lamarck, which have been found in estuarine areas, the first essentially marine species of this genus from along the Indian coasts was recorded from the Gulf of Manaar off Rameshwaram Island along the coast of Peninsular India, on the authority of the late Dr. Selenka, by Thurston ² under the name *Thalassema formulosum*; this name, however, as was shown by one of us ³ is only a *nomen nudum*, and unless the suggestion made in the paper cited of *T. formulosum* being a *lapsus calami* for *T. formosulum* Lampert is correct, the identity of the species from off Rameshwaram Island must remain doubtful. In 1919 a second marine species from the mud-flats at Chandipore, Orissa, was described by Prashad ⁴ under the name *T. microrhynchus*, but this species and *T. branchiorhynchus* Annandale and Kemp, which was also found in association with it in the same locality, appear to belong to the group of estuarine species ⁵ referred to above and need not be considered here. A second truly marine species from the chank-beds at Tuticorin in the Gulf of Manaar was, however, described by Prashad in 1920 in the paper cited under the name *T. hornelli*, ⁶ and this completes the records of the species which are known from along the coasts of India.

T. bombayensis differs from all other extra-Indian species in having 4-5 pairs of segmental organs. In this respect it is allied to *T. hornelli*, which also has 5 pairs of segmental organs, but differs from it in general form and in having 10-11 instead of 19 longitudinal muscle bands. The variable number of both the muscle bands and the segmental organs in *T. bombayensis* suggests that the species is still in the process of evolution in these respects. The greatly divided condition of the spiral lobes of the funnels of the segmental organs, which was found in one specimen, is also of special interest.

¹ Annandale, N. & Kemp, S. W., *Mem. Ind. Mus.*, V, pp. 58-63, text-figs. 1-3 (1915). See also Prashad, B., *Mem. As. Soc. Bengal*, VI, pp. 323-338, pl. xi (1919).

² Thurston, E., *Bull. Madras Mus.*, III, p. 116 (1895).

³ Prashad, B., *Rec. Ind. Mus.*, XIX, p. 35 (1920).

⁴ Prashad, B., *Rec. Ind. Mus.*, XVI, pp. 399-401, text-fig. (1919).

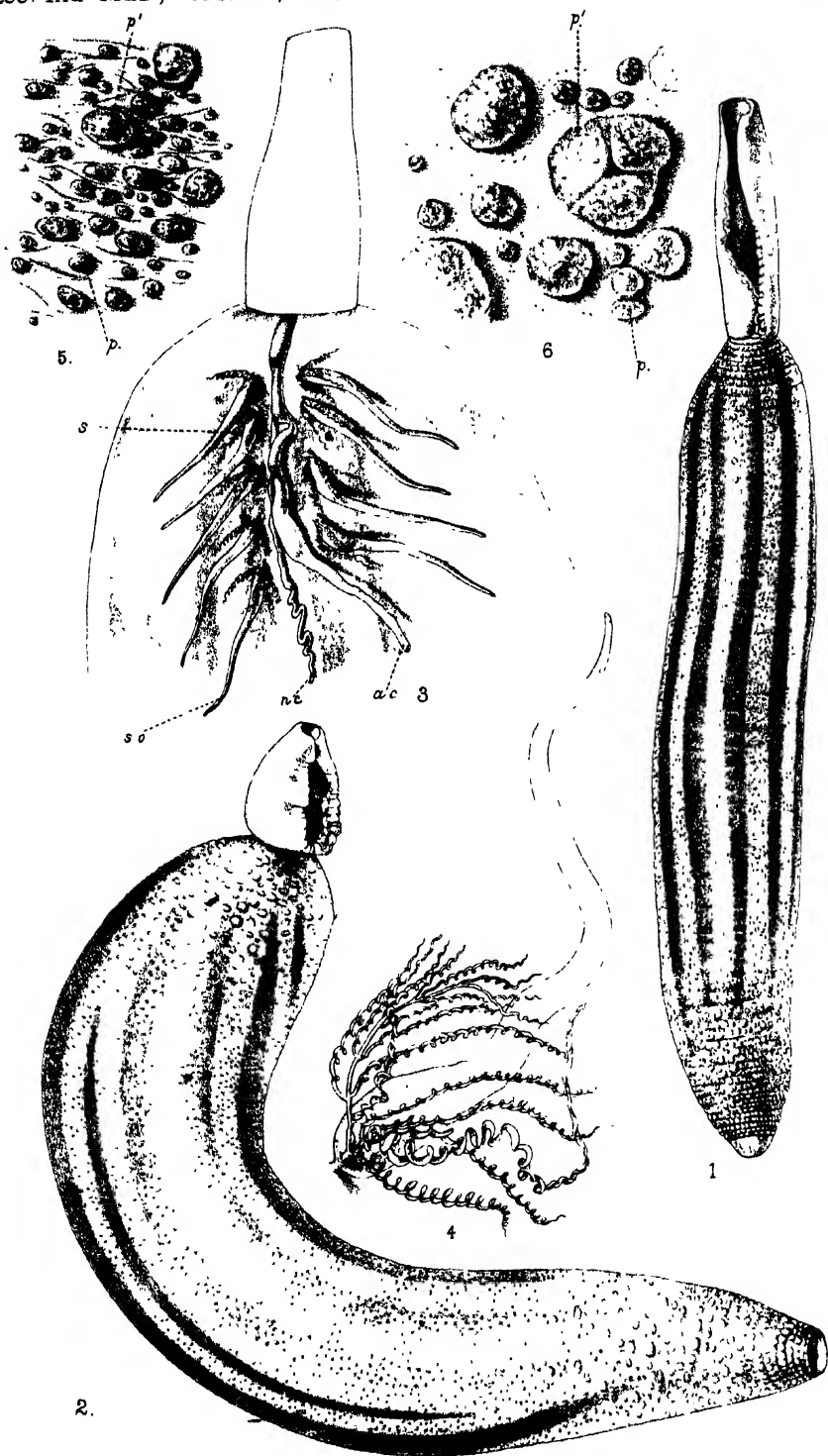
⁵ Annandale in *Bijdrag. Tot d. Dierkunde* (Max Weber Feest-Numer), p. 148 (1922) separated this interesting group of estuarine species together with *T. sabinum* Lanchester from Siam into a distinct genus for which he proposed the name *Anelassorhynchus*. Anatomically, however, these forms do not differ in any respect from the other marine species of the genus *Thalassema* Lam., and it is very doubtful whether the slight differences in the "structure, function and physiology of the proboscis" are enough for separating them into a distinct genus. It may also be noted here that no species had ever been described by Annandale & Kemp under the name *Thalassema gangetica* and apparently this name is synonymous with *Thalassema branchiorhynchus* Annandale & Kemp which was originally described from the Gangetic Delta. The page reference to this species in the *Mem. Ind. Mus.* should be 61 and not 56 as given by Annandale in the paper cited.

⁶ Prashad, B., *Rec. Ind. Mus.*, XIX, pp. 36, 37 (1920).

EXPLANATION OF PLATE XII.

Thalassema bombayensis, sp. nov.

- FIG. 1. Holotype with the expanded proboscies as seen from the ventral surface. Natural size.
- FIG. 2. Another specimen preserved in 10 per cent. formalin, showing the contracted proboscis, arrangement of tubercles and papillae. Natural size.
- FIG. 3. Anterior part of a dissected specimen showing the arrangement of the segmental organs. In this specimen there are 5 segmental organs on the left and only 4 on the right side; slightly enlarged. *a. c.* alimentary canal; *n. c.* nerve cord; *s.* inner end of seta; *s. o.* segmental organ.
- FIG. 4. A segmental organ, as seen from the ventral side, showing the vesicle and the much divided spiral lobes of the funnels, $\times 16$.
- FIG. 5. Papillated area of the skin from the middle of the body, $\times 16$. *p'* small papilla; *p* larger tubercle formed by the union of small papillae.
- FIG. 6. Tuberculated area of the skin from near the posterior end of the body, $\times 16$. Reference lettering same as fig. 5.



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THALASSEMA BOMBAYENSIS, sp. nov.

DESCRIPTION OF A NEW GENUS AND SPECIES OF GEOPHILIDAE (MYRIAPODA, CHILOPODA) FROM MADRAS (INDIA).

By F. SILVESTRI.

Gen. *Mixophilus*, nov.

Body anteriorly and posteriorly slightly narrowed. Head small, not completely covering the lateral part of first segment of the maxillipedes, with the sides converging a little anteriorly. Antennae somewhat attenuate, sparse, setose. Labrum very small, provided with four teeth medially; mandibles with one pectinate lamella, the teeth of which are very short and similar; first maxillae with the entire coxosternum provided with a submedian triangular, tapering process, which has a seta at its base internally and inferiorly; maxillary palp biarticulated; its second article longer than the first, bearing a seta on its lower surface; second maxillae with an entire coxosternum and a 3-jointed palp provided with a distinct subconical claw.

Frontal lamina coalesced; prebasal lamina scarcely distinct, basal lamina broad, trapezoidal. Maxillipedes separated from the frontal margin of head by a long distance; first joint long and strong, second and third very short, all unarmed, claw long, somewhat curved, and at base armed with a small tooth, subcoxosternum with entire chitinous lines, anterior margin unarmed and medially very faintly sinuate.

Segments provided with short and trapezoidal pretergites; tergite transversely subrectangular; pleurae with prescutellum somewhat larger than the spiracular scutellum; sternites with presternum in the middle faintly and incompletely divided, sternum provided (last pediferous excepted) with glandular pores disposed in a posteriorly situated entire area on a number of segments in the anterior part of the body and in two posteriorly situated areas on the remaining segments.

Legs short, provided with an unguiform terminal joint, strong, bearing basally a seta a little shorter than the claw.

Last pediferous segment provided with an obtrapezoidal sternum and with numerous glandular pores, which open in a large common pit as shown in fig. 3, *a*; legs 7-jointed including the last claw, little longer than the preceding legs, and in female very little more attenuate than in male.

Anal pores present.

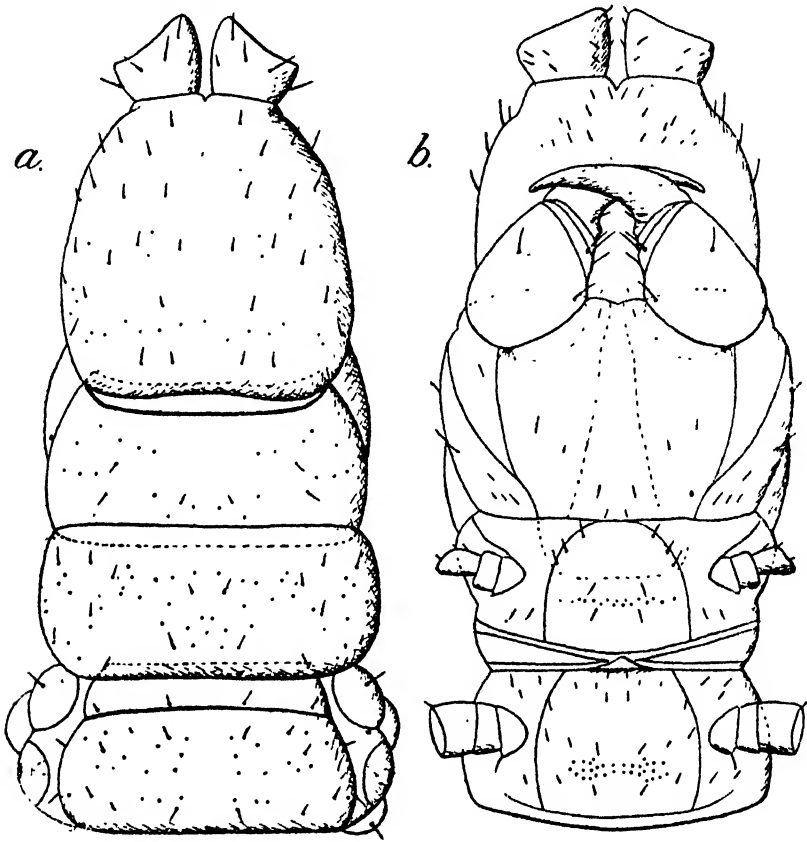
Genotype: *Mixophilus indicus*, sp. nov.

Remarks: This genus is related to *Henia* C. L. Koch and to *Chaetechelyne* Mein., but it differs from both in the form of the labrum, in the distribution of sternal pores, and from the first in the legs of the last pediferous segment being provided with an unguiform joint (claw) and from the second in the basal laminae being very much longer.

Mixophilus indicus, sp. nov.

Body light leather-coloured, with head and maxillipedes, except for the black claw, of an ochre-amber colour.

Sterna sparsely and shortly setose and provided with a posterior entire area of glandular pores up to segment xvii, which in the xviii segment are about 70 in number; the glandular areas become medially interrupted from segment xviii onwards and the lateral groups become gradually less numerous; in the last ambulatorial segment each lateral group is composed of about 9 pores only.



TEXT-FIG. 1.—*Mixophilus indicus*: a, b. Dorsal and ventral aspect of anterior part of body.

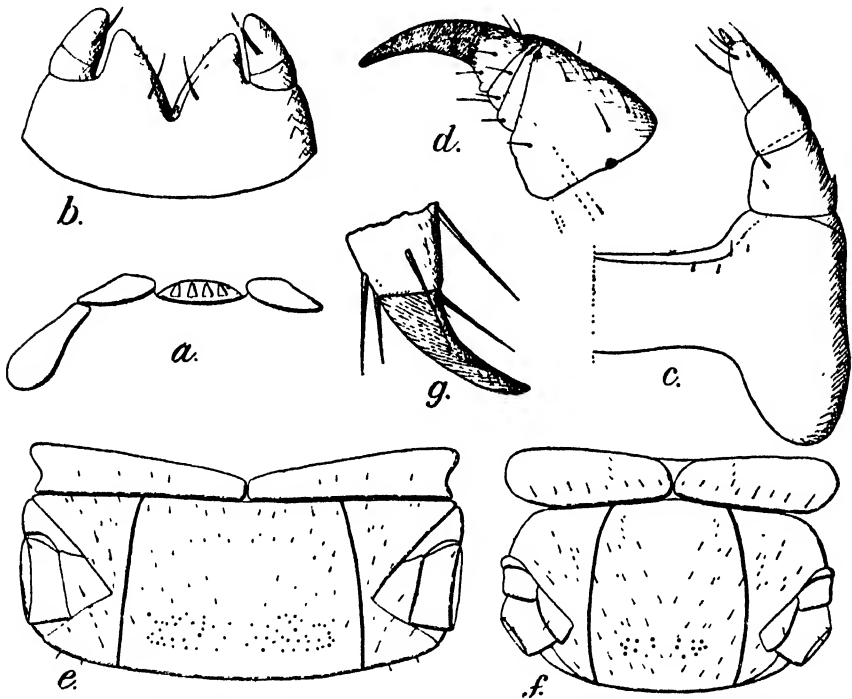
Pairs of legs in the female 57, in the males 55-57.

Length of body 20 millimetres, breadth 1 millimetre.

Described from one female and 5 males collected by Prof. Bonavis Bonnell at Madras.

[*Mixophilus indicus* here described by Prof. Silvestri was secured for the first time about the end of July, 1928 from a piece of land in the bed of the Cooum River at Madras, surrounded by water not less than 2½ feet deep, to a distance of about 10 to 12 feet on all sides. This bit of land, which is situated in the southern arm of the Cooum between the Gymkhana and Government House, is frequented by fishermen who collect Polychaete worms of the genera *Marphysa* and *Lycastis*. The forms were obtained when search was made for *Lycastis* and the extremely fine specimens lay coiled within loose soft mud just as these

Polychaetes do. These forms of a pale brownish yellow tint differed in colour from *Lycastis*, which is of a fleshy red colour, and were thought to be young forms of *Lycastis*. One fact, however, noticed at the time was the quickness with which they took cover, and on careful examination in the laboratory they were found to be centipedes belonging to the Geophilomorpha.

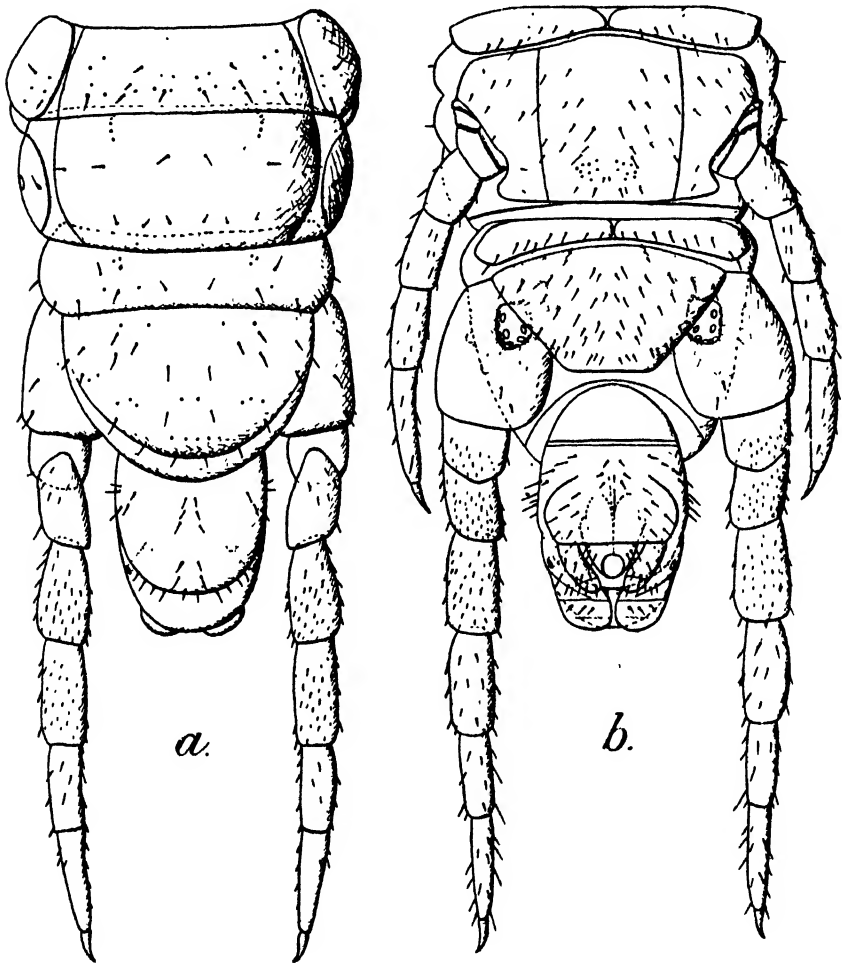


TEXT-FIG. 2.—*Miraphilus indicus* : a. Labrum, ventral view; b. First maxillae; c. Half part of second maxillae; d. One of the prehensile feet; e. Ventral aspect of xviii segment; f. Ventral aspect of last ambulatorial segment; g. Distal part of tarsus and pretarsus.

On subsequent occasions they were obtained from heaps of soil sticking out of the water from the bed of the Cooum at a point east of the Island ground and towards the Napier bridge. The heaps were piled up by fishermen while digging for *Marphysa*. That nearest to the shore was about three feet away and the others were separated by intervals of two to three feet. In the superficial layers of these heaps the centipedes were found coiled up and making practically no attempt to escape or leave the place. Along with these certain Forficulids, which were seen to run on the water and cross from one mound to another, were also obtained.

It had recently been decided by the Corporation of Madras to flood the Cooum periodically with water pumped in from the sea. The operation began for the first time in the end of July and since then the mounds and the piece of land in the bed of the Cooum have been submerged, becoming visible only occasionally for a few hours at a stretch. When the mounds are thus exposed to view no trace of these centipedes can

be found. On the assumption that they had migrated to the shore excavations were made between the maximum and minimum water levels. At first this search appeared unsuccessful, but later it was discovered that they lived in the very loose sand of crab-burrows along with Amphipods and Isopods. The burrows were a few days old. It is probable that these Geophilids move about during the night in search of food and occupy the heaps at the mouth of crab-burrows expecting to find food from the remains of the food of the crabs and also shelter. Pocock mentions that *Linotenia maritima* was found with hosts of scuttling woodlice and hopping sand-shrimps (Zoologist (Ser. 4) IV, p. 484, 1900) similar to what was observed in the present case.



TEXT-FIG. 3.—*Mixophilus indicus*: a, b. Dorsal and ventral aspect of posterior part of body.

The questions that arise now are whether these Geophilids were obtained from the first and second locality by mere accident or whether they represent their natural habitat. If the latter, whether there are

any peculiarities in structure which enable them to cross water and to withstand submergence for short periods. The accident theory does not seem to be tenable, for it fails to account for their occurrence in large numbers in these places, or to explain why out of several forms found on land this particular form alone should be unfortunate enough to be stranded.

The new species *Mixophilus indicus* here described is also interesting in that it has succeeded in the struggle for existence by adapting itself to a new kind of diet, namely the flesh of the polychaetes. *Mecistocephalus*, a common Geophilid, though distributed in almost every garden in Madras and even in the Island ground itself has not yet been found in places where *M. indicus* was collected.

The Polychaete *Lycastis* is regarded as an aquatic form tending towards life on land through the reduction of the parapodia and the simpler nature of the dorsal cirri which act as gills. In *Mixophilus indicus* we probably have a Geophilid in the process of changing its habitat in the reverse direction and it appears as if the two animals are adapting themselves in opposite directions. B. Bonnell.]

SPONGES AND POLYZOA OF THE INDAWGYI LAKE, BURMA.

By H. SRINIVASA RAO, M.A., D.Sc., Assistant Superintendent, Zoological Survey of India.

In the fauna of the lake the sponges and Polyzoa are very poorly represented. Only one species of sponge and three of Polyzoa were found in the marginal zone of the lake. The specimens were obtained on a species of stout reed common in the marginal area and on leaves of other aquatic plants. *Hislopia lacustris*, the commonest species of Polyzoa in the lake, was also found encrusted on the outer surface of the shells of *Viviparus indawgyiensis* Rao.¹

The species of sponges and Polyzoa living in the lake are common in most parts of India and Burma. Their range often extends beyond the Indian Empire to other outlying countries of Asia and to Africa.

The following species were found in the lake :—

SPONGES.

Trochospongilla latouchiana Annandale.

POLYZOA.

Hislopia lacustris Carter.

Plumatella (Afrindella) tanganyikae Rousselet.

Lophopodella carteri (Hyatt).

SPONGES.

Trochospongilla latouchiana Annandale.

1907. *Trochospongilla latouchiana*, Annandale, *Journ. As. Soc. Bengal*, III, p. 21.

1911. *Trochospongilla latouchiana*, Annandale, *Faun. Brit. Ind. Freshwater Sponges*, etc., p. 115.

This sponge was found at the northern end of the lake near Nyaungbin growing on stout reeds, many of which bore colonies of *Hislopia lacustris*. It is very thinly encrusted and does not exceed more than two inches in length along the reed. In spirit it has a slaty gray colour. Gemmules were not very numerous, but the few present are found attached to the base of the sponge.

In Burma the species has been previously recorded from Tenasserim. It was curiously absent in the Inle Lake in the S. Shan States.

POLYZOA.

Suborder CTENOSTOMATA.

Hislopia lacustris Carter.

1918. *Hislopia lacustris*, Annandale, *Rec. Ind. Mus.*, XIV, p. 78, pl. xxi, fig. 4.

The species occurs commonly on reeds and leaves of aquatic plants, and on shells of *Viviparus indawgyiensis* at the northern end of the lake

¹ The species is described on p. 279.

near Nyaungbin and at the southern end near Lonton. The aperture of the zooecia is square in outline and bears at each corner a well-developed spine. The spines have apparently dropped in some parts of the zooaria.

The species is probably widely distributed in the Indian Empire, but the typical form has been recorded mostly from N. India and Lower Burma.

Order PHYLACTOLAEMATA.

Plumatella (*Afrindella*) *tanganyikae* Rousselet.

1912. *Plumatella* (*Afrindella*) *tanganyikae*, Annandale, *Rec. Ind. Mus.*, VII, p. 142.¹

With some hesitation I refer to this species a small colony found growing on a blade of grass at the north end of the lake near Nyaungbin. None of the polypides is expanded. Owing to the opaque nature of the ectocyst the form of the lophophore is difficult to make out. No statoblasts are present in any part of the colony. The stiff ectocyst and the truncated and minutely roughened zooecia, and the branching of the zooaria give the colony a close resemblance to this species, and in several respects it agrees with the original description of the species.¹

The colour of the zooaria in spirit is dark brown, but the ventral surface of the colony and the terminal parts of individual zooecia are paler in colour. The surface of the zooaria is nearly smooth, especially the flat ventral portion, but the curved upper surface is covered chiefly with the remains of diatoms. A few minute sand grains and broken sponge spicules are also found amongst the diatoms. No furrows or annulations are present on any part of the zoecium. The edge of the zoarium at the junction of the flat and curved parts is produced into a narrow thin velum at the sides which also contains particles of sand and other debris. The distal part of each zoecium, particularly of the younger ones, projects more or less vertically in the form of a triangular spine. The aperture of the zoecium is elongate-oval and is closed by a pale membranous structure.² The lower extremity of the stomach is somewhat produced and mammiliform.

In the absence of statoblasts it is impossible to fix the identity of the species with certainty. The species, if not identical with *P.* (*Afrindella*) *tanganyikae*, is very closely related to it in the form and branching of the zooaria.

The ectocyst, which is densely covered mostly with the remains of diatoms, presents a noteworthy feature, and this is presumably to be associated with the fact that the lake teems with these organisms which on death settle on the bottom debris.

The distribution of *P. tanganyikae* is somewhat peculiar. It was first described from Lake Tanganyika in Central Africa, and has since been recorded in India from the W. Ghats in the Bombay Presidency, from the Kumaon Lakes in the lower ranges of the Western Himalayas and from Orissa in the Peninsular area. The discovery of the species

¹ Rousselet, *Proc. Zool. Soc. London*, (i), p. 252, pl. xiv, figs. 1-4 (1907).

² This structure is fully described and figured by Annandale in *Rec. Ind. Mus.* VII, pp. 140-142 (1912).

in Burma from which, so far as I am aware, there has been no previous record, is of some interest. Though from its known records the species seems to have a discontinuous distribution it is probable that on a careful and extended survey of freshwater areas in the Indian Empire the species will be found to have a much wider range.

***Lophopodella carteri* (Hyatt).**

1911. *Lophopodella carteri*, Annandale, *Faun. Brit. Ind. Freshwater Sponges*, etc., p. 232.

1919. *Lophopodella carteri*, Annandale, *Rec. Ind. Mus.*, XVIII, p. 96.

A small young colony found on the thick leaf of a reed in the marginal zone of the lake near Nyaungbin is to be referred to this species. No statoblasts were found in any part of the colony, the polypides of which were preserved in a beautiful expanded condition. The ectocyst is hyaline and forms a trumpet-shaped structure, to the narrow end of which the polypide is attached. When fully expanded the polypide projects considerably above the flat side of the 'trumpet', its proximal part being protected by the entire ectocyst. In the contracted state the polypide lies well within the trumpet-shaped ectocyst. A thin membrane, having a cellular structure, seems to invest the ectocyst and the polypide. The cells are regularly arranged, and more or less spherical, and have their individual outline distinct over the whole membrane.

The distribution of the species in the Indian Empire is not fully known. The species has been recorded from Seistan in Eastern Persia, from the Bombay Presidency and the Central Provinces and from the Kumaon Lakes in the Western Himalayas. It is not known from other freshwater lakes, such as the Loktak Lake in the Manipur State of Assam or from the Inle Lake of the S. Shan States in Burma, the fauna of which has been investigated in recent years. The present record of the species from the Indawgyi Lake in Upper Burma is, therefore, of considerable interest. The range of the species extends from East Africa to Japan.

THE FRESHWATER AND AMPHIBIOUS GASTROPOD MOLLUSCS OF THE INDAWGYI LAKE AND OF THE CONNECTED FRESHWATER AREAS IN THE MYITKYINA DISTRICT, BURMA.

By H. SRINIVASA RAO, M.A., D.Sc., Assistant Superintendent, Zoological
Survey of India.

The Gastropod molluscs dealt with in this paper were collected by Dr. B. Chopra during the cold weather of 1926 in the Indawgyi Lake and its environs, in the plains lying to the north of the lake, and in the freshwater areas round about Kamaing, all in the Myitkyina District, Upper Burma. The lake, as well as the various streams, channels and pools in the areas mentioned above, are indirectly connected with the Irrawady river system in Upper Burma.

The physical features of the lake and the adjoining country are briefly referred to by Dr. B. Prashad and Mr. D. D. Mukerji in their paper on the Fishes of the Indawgyi Lake,¹ and it would be enough to point out here that the physical conditions of the lake do not seem to be particularly conducive to the growth and differentiation of a varied molluscan life. Taking into consideration the size of the lake, its depth, and the suitability of the marginal areas as a zone for aquatic life, the Gastropod fauna actually found in the lake can by no means be said to be rich in species, though the number of individuals of certain species found living in the lake is large.

The fauna is represented by 7 families of Gastropod molluscs of which four belong to the order Pectinibranchiata, and three to the Order Pulmonata. Twenty-two species belonging to 14 genera were found in the areas surveyed. Six species and one form are new, but of these new species only two belong to the lake fauna proper; the remaining four are either inhabitants of streams and pools in the neighbourhood of the lake and closely connected with it, or of rocky or muddy streams in the vicinity of Kamaing, about 50 miles north of the lake. All the six species are presumably endemic in the Indawgyi Valley.² Of the remaining sixteen previously known species some are widely distributed in the Oriental Region, some are common to India and Burma, while a few are Burmese in origin and distribution.

In this paper I have also given descriptions of two new species of the Melaniid genus *Paludomus* from Lower Burma as they are very closely related to two other species, also new, which were found in the streams and pools in the plains north of the Indawgyi Lake.

In the preparation of this note the field-book of Dr. Chopra containing notes on the physical features and the fauna of the lake and the surrounding country has been of great help to me, and I take this

¹ Prashad, B. & Mukerji, D. D., *Rec. Ind. Mus.*, XXXI, pp. 161-223, pls. vii-x (1929).

² For the sake of convenience the words "Indawgyi Valley" are used in this and the following pages to indicate the entire area surveyed by Dr. Chopra from the southernmost point of the lake to the plains in the vicinity of Kamaing in the Myitkyina district.

opportunity to thank him for permitting me to make use of his copious notes.

The drawings illustrating this account have been made under my supervision by Babu A. C. Chowdhury, Senior Artist in the Zoological Survey, with his habitual skill.

Before discussing the general aspects of geographical and ecological distribution of the species of molluscs found in the Indawgyi Valley it will be convenient to enumerate the species occurring in that area.

PECTINIBRANCHIATA.

Viviparidae.

Viviparus bengalensis (Lam.).

* *Viviparus bengalensis* race *doliaris* (Gould).

† *Viviparus indawgyiensis*, sp. nov.

Ampullariidae.

† *Pila theobaldi* (Hanley).

Rissoidae.

Digoniostoma pulchellum (Benson).

* *Parafossarulus sulcatus*, sp. nov.

† *Bithynia (Alocinma) expansilabris*, sp. nov.

Tiaridae (Melaniidae).

* *Acrostoma baccata* f. *lirata* Rao.

Melanoides tuberculatus (Muller).

Melanoides scabra (Muller).

* *Paludomus regulata* Benson.

† *Paludomus crassicallosa*, sp. nov.

† *Paludomus kamaingia*, sp. nov.

PULMONATA.

Limnaeidae.

Limnaea acuminata f. *patula* Troschel.

† *Limnaea acuminata* f. *pseudohorae*, nov.

Limnaea luteola f. *australis* Annandale & Rao.

† *Limnaea decussatula*, sp. nov.

Planorbidae.

Indoplanorbis exustus (Deshayes).

Gyraulus convexiusculus (Hutton.)

Gyraulus rotula (Benson).

* *Gyraulus velifer* (Annandale).

* *Gyraulus velifer* var. *ciliata* (Annandale).

Segmentina calathus (Benson).

Hippeutis sp.

Succineidae.

Succinea graveyi f. *deccanensis* Rao.

Species marked with an asterisk are essentially Burmese in origin and distribution, while those marked with a dagger are probably endemic in the Indawgyi Valley.

Most of the genera from the Indawgyi Valley are met with in most parts of the Indian Empire. Some are widely distributed in the Oriental

Region, while a few have a restricted distribution in India and Burma. The genus *Hippieutis* has so far been recorded from the Manipur Valley in Assam. In the Indawgyi Valley it is represented by a few dead shells, the specific identity of which is difficult to determine owing to poor preservation. The discovery of the genus, however, in the relatively contiguous valleys of Manipur and Indawgyi, both of which are indirectly connected with the Irrawady river system, seems to suggest the possibility of a wider distribution of the genus in the hill-tracts of Assam, Burma and China. *Parafoassarulus* presumably represents the only distinct Chinese element in the Burmese Gastropod fauna, but its distribution in Burma appears to be restricted to the Shan plateau and to parts of Upper Burma. *Digoniostoma* has hitherto been known only from parts of Bengal and Assam, and from Peninsular India. The present record of its occurrence in Burma is, therefore, of some interest from the point of view of geographical distribution. From the Shan plateau, which lies east of the Irrawady basin and the mollusc fauna of which is now fairly well known, there is no record of this genus from as far as the Shivel Valley on the Chinese Frontier in the north to the Inle Lake in the south. The subgenus *Alocinma* has a wide range extending from Mesopotamia through Peninsular India to Upper Burma. *Acrostoma* and *Paludomus* have a more or less restricted distribution in the eastern part of India, and in South India and Ceylon; in Burma, however, they are represented by a large number of species which are common in the river-systems of that province. Perhaps it may be said that they are two of the most dominant genera of the freshwater Pectiniibranchs in Burma. The remaining genera are widely distributed in the Oriental Region, if not over the whole world.

With the exception of the six new species, which are probably endemic in the Indawgyi Valley, the distribution of all others is well known. *Indoplanorbis exustus*, *Melanoides tuberculatus*, *Melanoides scabra* and *Gyraulus convexiusculus* have a very wide distribution in the Oriental Region. Six species which may be ascribed to India proper are *Viviparus bengalensis*, *Digoniostoma pulchellum*, *Limnæa acuminata*, *Limnæa luteola*, *Segmentina calathus* and *Succinea gravelyni*, but their distribution within the Indian Empire is either very wide or apparently discontinuous as in the case of the last-named species, which has hitherto been recorded from Madras, the Deccan, the Andaman Islands and Burma.

The following species may well be regarded as Burmese in origin and distribution : *Pila theobaldi*, *Acrostoma baccata*, *Paludomus regulata*, and *Gyraulus velifer*. The last named species was first described from the Inle Valley, and is as yet known only from one other locality, e.g., the Indawgyi Lake. *Gyraulus rotula* must still be considered as a rare species. It was originally described from Moradabad in N. India, and was subsequently found in the same locality and in Ceylon. The discovery of this species in Burma is, therefore, of great interest.

It will thus be seen from the facts of distribution given above that the Gastropod fauna of the Indawgyi Valley consists of a large proportion of species having a wide distribution in the Oriental Region or in India proper, and of a comparatively small proportion of Burmese species if we exclude the new species described in this paper. It is clear,

at any rate, that the Gastropod fauna of the valley is of mixed origin, though it is not possible to be definite about the relative numbers of the species derived from the Indian and Burmese areas respectively.

In enumerating the facts of ecological distribution it will perhaps be of some value to arrange the species found in the Indawgyi Valley in accordance with their habitat, and in the following list the species occurring in the valley are distributed in three groups. A species occurring in one or more habitats is put down in as many groups.

| Species from the marginal zone of the lake, and also from pools and streams near the shore. | Marginal or deeper parts of the lake only. | Streams and pools of the plains north of the lake not directly connected with it. |
|---|--|---|
| — | <i>Viviparus indawgyiensis</i> . | — |
| <i>Viviparus bengalensis</i> | — | — |
| <i>V. bengalensis</i> race <i>doliaris</i> | — | <i>V. bengalensis</i> race <i>doliaris</i> |
| <i>Pila theobaldi</i> | — | <i>P. theobaldi</i> |
| <i>Digoniostoma pulchellum</i> | <i>D. pulchellum</i> | <i>D. pulchellum</i> |
| <i>Bithynia (Alocinma) expansilabris</i> | — | — |
| <i>Parafossarulus sulcatus</i> | — | — |
| <i>Acrostoma baccata</i> f. <i>lirata</i> | — | — |
| <i>Melanoides tuberculatus</i> | — | <i>M. tuberculatus</i> |
| — | <i>Melanoides scabra</i> | — |
| <i>Paludomus regulata</i> | — | <i>P. regulata</i> |
| — | — | <i>P. crassicallosa</i> |
| <i>Limnaea acuminata</i> f. <i>patula</i> | — | — |
| — | — | <i>Paludomus kamaingia</i> |
| — | <i>L. acuminata</i> f. <i>pseudohorae</i> | — |
| <i>L. luteola</i> f. <i>australis</i> | — | — |
| — | <i>L. decussatula</i> | — |
| <i>Indoplanorbis exustus</i> | — | <i>I. exustus</i> |
| — | <i>Gyraulus velifer</i> | — |
| — | <i>G. velifer</i> var. <i>ciliata</i> | — |
| <i>Gyraulus convexiusculus</i> | — | — |
| <i>Gyraulus rotula</i> | — | — |
| <i>Segmentina calathus</i> | — | — |
| — | <i>Hippeutis</i> sp. | — |
| <i>Succinea graveyi</i> f. <i>deccanensis</i> | — | — |

It will be seen from this list that there are few species which exclusively inhabit the lake proper, and still fewer which are, in the strict sense of the term, fluviatile. On the other hand many species, which inhabit the streams and pools not in the immediate vicinity of the lake but also in the plains north of it, are actually found in the marginal zone as well. The species given in the second column of the list have, with one exception, e.g., *Digoniostoma pulchellum*, all been found in the marginal zone of the lake, but nowhere else in the neighbourhood of the lake or in the plains near Kamaing. *D. pulchellum* usually inhabits sluggish streams with a muddy bottom and aquatic plants, and pools or swamps with some amount of weeds. In the lake and the connected waters in its vicinity the species appears to be stunted, whereas it attains its full development in size in the muddy streams and pools round about Kamaing. Specimens from the deeper parts of the lake were all dead. *Viviparus indawgyiensis* and *Limnaea decussatula* both seem to be lacustrine, and have not been found outside the marginal zone of the lake. The evidence for this statement with regard to the latter species (which has been described from a single specimen) is not conclusive, but with regard to the former it may be said that it is the only Gastropod which dominates the molluscan life in the lake. The deeper central parts of the Indawgyi Lake, which consists of soft sticky clay at the bottom and very little macroscopic vegetation, do not seem to support molluscan life, and it is not surprising that so few individuals of any species were found living in the central parts of the lake, and that there were few, if any, living species of Invertebrate animals in these parts. On the other hand Dr. Chopra found molluscs quite abundant in the marginal area, which is, as a rule, shallow in most parts of the lake, and has a fair quantity of aquatic weeds and an abundance of floating microscopic plant-life.

The aquatic species noted in the first column are generally inhabitants of ponds and swamps or sluggish streams, but *Acrostoma baccata* f. *lirata* and *Paludomus regulata* do not strictly belong to this habitat group, and their occurrence in the lake area is probably accidental. The occurrence of the remaining species (some of which are more or less paludine in habit) in the marginal zone of the lake is to be accounted for by the fact that during heavy rains the water brought down by the various hill-streams flowing into the lake swells its volume to such an extent that the swamps and pools on the shores of the lake in normal times are submerged and become part of the lake. Consequently the inhabitants of the swamps come to occupy the shallower regions of the lake where the conditions of life approximate to those of a swamp. Of the species enumerated in the third column the two new species of *Paludomus* from Kamaing are inhabitants of rocky streams, and are probably rupicolous; the remaining species are much at home in the marginal zone of the lake as in muddy streams and pools of the plains in the valley.

Family VIVIPARIDAE.

Viviparus Montfort.

1928. *Viviparus*, Rao, *Rec. Ind. Mus.*, XXX, p. 416.

This genus is represented in the fauna of the lake and of the surrounding country by only two species. One is the well known

V. bengalensis so common in most parts of India, and the other is a new species found only in the lake, and probably endemic in it. Of the former, the race *doliaris* seems to have a wide distribution in Burma, while the forma *typica* is represented by a dwarfed phase which is not common in Burma as it is in parts of India.

***Viviparus bengalensis* (Lamarck).**

1921. *Vivipara bengalensis*, Annandale, *Rec. Ind. Mus.*, XXII, pp. 267-271, pl. i, figs. 1-3.

Individuals of this species belong to the forma *typica*. In form they are relatively dwarfed, and smaller than specimens taken in various parts of India. Presumably they never grow to a large size. The spiral bands on the shell are not usually conspicuous. The umbilicus is obsolete, but rarely takes the form of a small chink. In some young individuals the secondary spiral ridges of the embryo persist.

Specimens of this species were taken in small numbers from the shallower parts of the lake near the shore at Lonton, Loimon and Nyaungbin, small villages close to the lake.

There seem to be very few records of the forma *typica* from Burma. It is probable that this form was at one time dominant in Burma and that its place was later on taken by the race *doliaris*, which at present seems to be the commonest representative of *V. bengalensis* in that province.

***Viviparus bengalensis* race *doliaris* (Gould).**

1928. *Viviparus bengalensis* race *doliaris*, Rao, *Rec. Ind. Mus.*, XXX, p. 416.

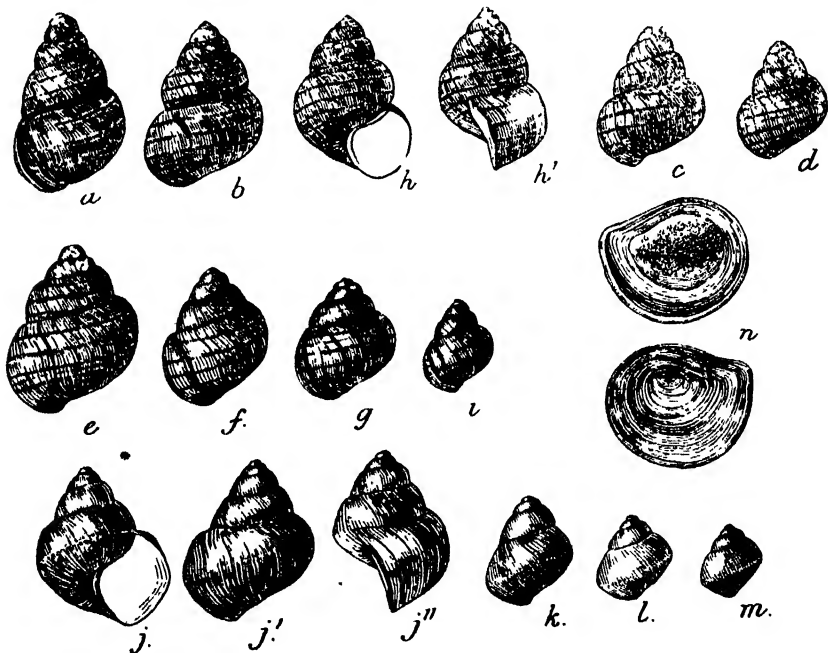
This is by far the commonest form in the ponds and sluggish streams in the country surrounding the lake, and in the shallower parts of the lake itself near the shore. Large numbers of shells and a few living specimens were dredged from the shallower regions of the lake in the vicinity of Loimon and Lonton; but some were found living on the submerged posts and stones forming the foundation of the Shwemyzu Pagoda, 3 miles south of Loimon. This form was also common in pools, near Lonton and Loimon, and in muddy or rocky streams in the vicinity of Kamaing, Hopin, Nyaungbin and Loimon.

This is apparently a well-established race in Burma. Its normal habitat is in muddy streams or pools. The occurrence of individuals of this race in large numbers in the shallower parts of the lake seems to be accidental. Owing to an exceptionally heavy rainfall in the year 1926 and the consequent flooding of the country round about the lake many of them had been washed down into the lake from the neighbouring pools and streams. Conditions of life in the shallower parts of the lake were presumably more or less similar to those obtaining in muddy ponds and streams, and the fact that a few continued to live in the lake seems to strengthen that presumption. Deep-water conditions in the lake are probably inimical to them, and it is not surprising, therefore, that a great proportion, if not all, of the specimens dredged from the deeper regions of the lake were dead.

Dr. Chopra informs me that the Shans break the shell partly and suck out the animal in the living condition.

***Viviparus indawgyiensis*, sp. nov.**

The shell is of moderate or small size, ovate to ovate-conical in outline and rather thick. The apex of the shell is usually blunt on account of its being worn. The colour of the shell varies from an olive-green to an olive-brown. There are usually eight well-defined but narrow brown spiral bands on the outside of the shell. There are 6-6½ gradually increasing convex whorls, and the suture is deeply impressed. There is very little flattening outside the suture, and the whorls present a telescoped appearance, the shells thus approaching a roughly scalariform condition. The sculpture consists of very minute spiral striae which are completely masked by the oblique, curved, longitudinal impressed lines which are well-marked on the last two whorls. These longitudinal lines give a characteristic appearance to the shell. On the body-whorl they are very prominent and often indistinguishable from the lines of growth found on the outer edge of the body-whorl. The number and prominence of the spiral bands on the body-whorl are subject to variability, but there are usually 8 bands, of which the third, fifth and sixth from above downwards are broader than the others. The body-whorl is slightly oblique. The aperture is broadly oval and never much longer than broad. Its anterior margin is broadly arched. The outer lip



TEXT-FIG. 1.—*Viviparus indawgyiensis*, sp. nov. a-m, shells of different sizes; the three figures marked b, h, h' are of the holotype; n, outer and inner views of the operculum.

is somewhat dome-like in outline and often broadly sinuate in the middle. It is thin and joins the inner lip posteriorly forming an acuminate projection directed towards the columellar side. The inner lip is relatively thick and its margin is somewhat raised but never reflected. The

interior of the mouth is smooth, bluish in fresh specimens of moderate size, white owing to a deposit of calcareous matter in dead shells, and deep-brown in good-sized, comparatively thick, fresh shells. The umbilicus is open and more or less rounded, into which the impressed longitudinal lines on the body-whorl converge.

The operculum is thin, broadly ovate in outline and concave on the external surface. The sculpture consists of coarse concentric striae. The muscle-scar on the internal surface is close to the internal margin, i.e., the columellar side of the operculum. It is thickened and raised into a boss and has a rough texture. Its colour is deeper than the rest of the operculum, and a faint whitish ring encircles the muscle-scar. The ground colour of the operculum varies from an yellowish-brown to claret, and in the centre the muscle-scar presents the appearance of a dark spot on the inner surface.

The measurements, in millimeters, given below are of a small series from various parts of the Indawgyi Lake:—

| Locality. | Height of shell. | Maximum breadth of shell. | Height of aperture. | Maximum breadth of aperture. |
|---------------------------|------------------------|---------------------------------|---------------------------|------------------------------------|
| Lolmon | 21.5 | 17.5 | 10.5 | 9.2 |
| | 19.0 | 16.5 | 11.0 | 8.5 |
| | 19.5 | 16.0 | 10.0 | 8.0 |
| Lonton | 23.0 | 18.5 | 11.5 | 9.5 |
| | 23.0 | 16.0 | 11.5 | 8.5 |
| | 19.0 | 17.0 | 11.0 | 9.0 |
| | 19.0 | 15.5 | 10.0 | 8.0 |
| Shwemyzu Pagoda | 20.0 | 15.0 | 10.5 | 8.5 |
| | 18.0 | 15.0 | 9.5 | 8.0 |
| Nyaungbin | 21.0 | 17.0 | 11.0 | 9.0 |
| | 21.0 | 15.5 | 9.0 | 7.5 |
| | 17.5 | 15.5 | 10.0 | 8.0 |

The edge of the mantle is moderately thick with a fairly well-developed sphincter muscle. It bears on its free margin several minute triangular or finger-like processes which vary in number and prominence. Their appearance in the living condition is not known as the expanded animal in nature has not been closely observed, but in most preserved specimens two or three finger-shaped processes and several comparatively small triangular ones may be detected. The gill-lamella is elongate and its base is slightly broader than the free part of the lamella.

The radular teeth closely resemble those of *V. bengalensis* and are subject to the usual variation and abnormalities observed in many species of freshwater molluscs. The internal anatomy is very similar to that of *V. bengalensis*. In the male the right tentacle is comparatively large and thickened. In the uterus there are usually one or two full-grown embryos and 6-8 ova, but exceptionally there may be as many as 5 embryos. The proportion in the numbers of male to female individuals is not the same in lots collected from different localities. In some places the males and females are equal in number, in others the females predominate. The embryonic shell consists of 3-4 whorls and

has a roughly diamond-shaped outline. The body-whorl is biangulate and bears no prominent spiral ridges or striations.

The embryonic shell is somewhat gray in colour and without spiral bands. It has 3 primary rows of chaetae and several secondary parallel ridges, but the chaetae are liable to drop off when the membranous covering of the embryo is removed. In the larger embryos, however, traces of the primary chaetae may be detected in a minute series of pits on the body-whorl. The secondary parallel ridges are often too minute to be detected. The sculpture of the embryonic shell undergoes modification as the individual grows. The spiral sculpture of the embryonic shell is more or less completely masked in the adult shell by the development of oblique longitudinal striae. The spiral ornamentation appears at first as fine olive-green lines on shells which have grown to a height of 10-15 mm., and as the shells grow further the spiral lines broaden out into bands.

Holotype.—M. $\frac{12841}{2}$ Zool. Surv. Ind. (*Ind. Mus.*).

Several hundreds of individuals of the species were dredged from various parts of the Indawgyi Lake, chiefly in the shallower regions near the shore at the north and the south ends of the lake, at Loimon and Lonton, and in the vicinity of the Shwemyzu Pagoda. Many of them were dead shells, but a comparatively small proportion consisted of living individuals. Dr. Chopra observed that samples of dredging in the deeper parts of the lake contained a large number of dead shells and very few living ones. This species seems to be restricted, therefore, to the shallower parts of the lake. The bottom consists of soft, sticky clay of a black colour in the deeper parts of the lake, of reddish clay in the shallow parts, and of a mixture of sand and mud in the intermediate zone. The water is usually clear, but has a greenish tinge on account of the great quantities of minute floating algae. The species seems to live on vegetable debris at the bottom. The Polyzoan *Histioplia lacustris* Carter is found growing on many shells from the marginal region.

There are two shells in the Zoological Survey collection found by the late Dr. R. Hungerford in what is called the 'Endawyne Lake, Burma', and labelled '*Vivipara sumatrensis* Dunker'. I have not been able to find a lake of that name in some of the standard atlases and maps of Burma which I have consulted, and the lake referred to in the label is presumably no other than the Indawgyi itself. The name has obviously been misspelt in transcription. The shells referred to are very different from specimens of *V. sumatrensis*, authentic examples of which have been recently presented to the Zoological Survey by Prof. Max Weber. In texture and ornamentation the two shells under discussion are almost identical with the new species described.

V. indawgyiensis appears to be dimorphic as evidenced by two forms which may be distinguished in collections from most parts of the lake. One is narrow and elongate, and the other is broad and compressed. Both the forms are always found together and in almost equal proportions.

The species is undoubtedly closely related to *Viviparus bengalensis* but differs in having a thicker shell, more convex whorls with deeply

impressed suture, and in the sculpture and ornamentation. The Assamese species *Viviparus crassa* (recorded also from Bengal and Burma) resembles the present species in sculpture and in having a thick shell, but the resemblance seems to be superficial as it differs from the latter in important features such as the form of the shell, the shape of the mouth, and in the total absence of spiral bands.

Family AMPULLARIIDAE.

Genus *Pila* Bolten.

1915. *Pila*, Preston, *Faun. Brit. Ind. Freshw. Moll.*, p. 96.

Pila theobaldi (Hanley).

1925. *Pila theobaldi*, Prashad, *Mem. Ind. Mus.*, VIII, p. 77, pl. xv, fig. 3.
1928. *Pila theobaldi*, Rao, *Rec. Ind. Mus.*, XXX, p. 425

Several living and dead individuals of this species were obtained from small, muddy streams and ponds in the vicinity of Lonton, Loimon, Kamaing and Hopin. Also from the western shores of the lake a few shells in a fresh condition were collected. They had presumably been washed down to the lake from the neighbouring streams and ponds. The examples from the Indawgyi system are all of moderate size, and are yellowish-green in colour. The spiral bands are more or less conspicuous in most of them. In larger specimens the spire is depressed, and the umbilicus is deep and broad.

The species is common in Upper Burma, and has been previously recorded from Bhamo, and from the Chinese Frontier of the N. Shan States. Its range in countries east and north of Burma is still imperfectly known.

The Shan inhabitants of the villages in the Indawgyi Valley, I understand, eat the animal by breaking the shell and sucking it out.

Family RISSOIDAE.

This family is represented by three genera, e.g., *Bithynia*, *Digoniostoma* and *Parafossarulus*. The first two are widely distributed in India, but the last is confined to China and Burma. Two species belonging to the first and the last named genera respectively are new to Science. *Digoniostoma* is represented by one species, hitherto known only from Assam.

Digoniostoma Annandale.

1920. *Digoniostoma* Annandale, *Ind. Journ. Med. Research*, VIII, p. 104.

Digoniostoma pulchellum (Benson).

1921. *Digoniostoma pulchellum*, Annandale, *Rec. Ind. Mus.*, XXII, p. 541.

The species is recorded for the first time from Burma. It was found in large numbers in the shallow as well as in the deeper parts of the lake near Lonton and Nyaungbin, in small pools and paddy fields near the shores of the lake at Lonton, in streams flowing into the lake at various

points, and in muddy pools or sluggish streams in the vicinity of Kamaing. Specimens from many parts of the lake do not seem to grow to as large a size as those living in pools and streams in the neighbourhood of Kamaing.

The distribution of the species is still imperfectly known. The species appears to be common in parts of Assam, and the adjoining districts of Burma. There are a few records from Calcutta in Bengal, Madras, Ellore and Secunderbad in S. India.

***Bithynia*¹ Leach.**

1928. *Bulimus*, Rao, *Rec. Ind. Mus.*, XXX, p. 427.

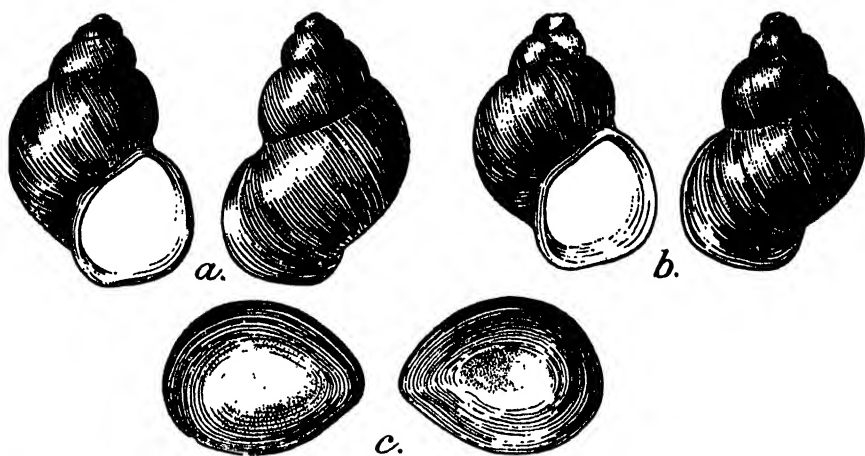
A single species hitherto undescribed and belonging to the sub-genus *Alocinma* was found in various parts of the lake.

***Bithynia (Alocinma) expansilabris*, sp. nov.**

The shell is of moderately small size, conico-ovate, longer than broad, and translucent in the fresh condition. It has $4-4\frac{1}{2}$ moderately convex whorls which increase rapidly in size. The apex when not eroded is somewhat obtuse, and the protoconch is very little elevated. The whorls are oblique, particularly the last, in dorsal view. The suture is well-defined¹ and transverse and leaves a minute step just outside it. The body-whorl has a broad trumpet-shaped outline in dorsal view. Its outer side is quite convex, while its anterior end is somewhat broadly produced. The aperture is oblique, roughly elliptical, produced both above and below, and broadest a little below the middle. The peristome is continuous. The outer lip is much more convex than the inner, expanded and slightly reflected at the edge, and is depressed broadly between its middle and the anterior projection. Its edge is smooth and sharper than the inner lip. The columella forms a smooth narrow ridge which has a silky lustre. The umbilicus is entirely closed, and even in very young individuals no chink is left between the body-whorl and the columellar ridge. The sculpture is minute and consists of longitudinal impressed striae. On the body-whorl the impressed striae converge towards the inner edge of the aperture. Traces of very minute spiral lines can sometimes be detected on the body-whorl when the shell is examined under the high power of the binocular microscope. These spiral lines probably represent the ground sculpture in the embryonic shell traces of which persist in the adult. The operculum is oval, produced above and rounded below, depressed in the centre of its outer surface and raised in the corresponding position on the inner side. The

¹ In a recent paper (*Rec. Ind. Mus.*, XXX, p. 427, 1928) on the Molluscs of the N. Shan States I revived the generic name *Bulimus* Scopoli for *Bithynia* Leach on obviously insufficient grounds, following Pilsbry and Bequaert (*Bull. Amer. Mus. Nat. Hist.*, LIII, p. 21, 1927). European Malacologists appear, at any rate, to have decided to ignore *Bulimus* as a substitute for *Bithynia*, as Kennard and Woodward have shown (*Proc. Malac. Soc. London*, XVI, pp. 125-127, 1924) that *Bulimus* is a typographical error for *Bulinus*. I am indebted to Mr. Woodward for kindly drawing my attention to this reference which I had unfortunately overlooked. I also understand that the whole question has been referred to the International Commission on Zoological Nomenclature for final opinion.

paucispiral figure is clearly seen on both sides and occupies a greater part of the central area of the operculum. It is enclosed by a number



TEXT-FIG. 2.—*Bithynia (Alocinma) expansilabris*, sp. nov. *a*, dorsal and ventral views of the holotype; *b*, the same views of another shell; *c*, outer and inner views of the operculum.

of concentric lines. The shell is translucent and is of a dull cream colour in the fresh condition, but opaque and of an yellowish or grayish colour in the dead shell.

Measurements in millimeters.

| Locality. | Height of shell. | Maximum breadth of shell. | Height of aperture. | Maximum breadth of aperture. |
|----------------------------------|------------------------|---------------------------------|---------------------------|------------------------------------|
| Lake near Nyaungbin pools . . . | 5.5 | 4.5 | 3.0 | 3.0 |
| Pools near Lonton . . . | 5.5 | 4.5 | 3.5 | 3.5 |
| Shores of lake near Lonton . . . | 5.8 | 4.2 | 3.0 | 3.0 |
| Pools near Nyaungbin . . . | 5.0 | 4.0 | 3.0 | 3.0 |
| Lake near Lonton . . . | 4.8 | 3.8 | 2.8 | 2.8 |

The radular teeth agree in many respects with the *Alocinma* type, but the central is slightly different. The basal ends of the central tooth are claw-like and produced inwards, and the processes in the centre of the tooth are relatively prominent. The genitalia closely resemble those of *Alocinma sistanica*.

Holotype.—M. ¹²³⁴³/₂ Zool. Surv. Ind. (*Ind. Mus.*).

The species was found living in small pools or streams near Lonton and Nyaungbin, and in the shallower parts of the lake near the shore at these places and on submerged posts of the Shwemyzu Pagoda. A large proportion of the specimens taken from the lake were, however, dead shells.

The affinity of this species to Indian, Burmese or Chinese species of *Bithynia* is not quite clear, but the species seems to belong to the fourth group or the *B. fuchsiana* group of Walker.¹ The species is

¹ Walker, *Amer. Journ. Hygiene*, Monograph Series, No. 8, p. 226 (1927).

probably endemic in the Indawgyi Valley, and does not resemble any of the known Indian or Burmese species of *Alocinma*. In the shape of the mouth and in the character of the lip it stands quite distinct.

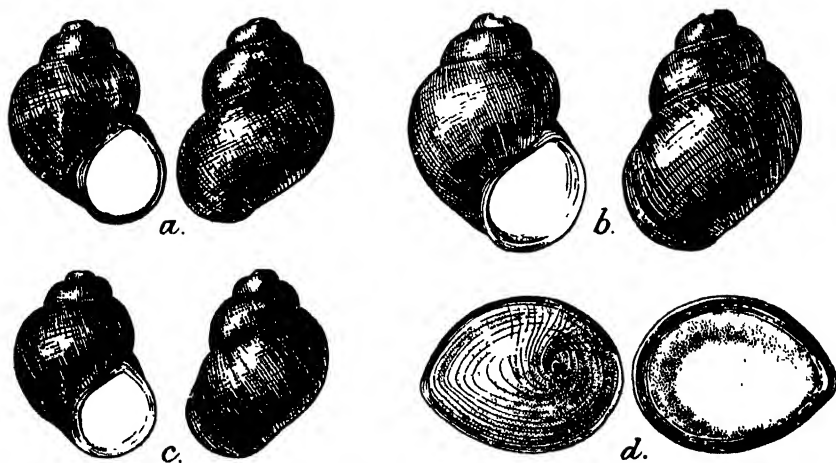
***Parafossarulus* Annandale.**

1928. *Parafossarulus*, Rao, *Rec. Ind. Mus.*, XXX, P. 429.

This genus is represented by a single undescribed species. It is probably confined to the hill-districts of Upper Burma, but with only two records from Burma it is impossible to say anything definite about the distribution of the genus in that country.

***Parafossarulus sulcatus*, sp. nov.**

The shell is oval, only slightly longer than broad, and has $3\frac{1}{2}$ -4 convex whorls which increase rapidly in size. The apex is obtuse and often broadly flattened. The whorls are oblique, particularly the last. The suture is clearly defined and well-impressed, and the whorls outside it are slightly flattened. The body-whorl is large, broader than high, and evenly convex. The breadth at the base of the penultimate whorl is three-fourths of the maximum breadth of the body-whorl. The aperture is nearly half as high as the shell, broadly oval, and widest at or a little below the middle. Its posterior extremity is produced, while its anterior is more or less rounded, but where the inner and outer lips meet in front a right angle is formed. The peristome is continuous and the inner lip is relatively thick, smooth and shining, and exceptionally laminated near the posterior end. The umbilicus is almost closed, but a slight chink may be detected in an oblique ventral view between the columellar callus and the shell. The naked-eye appearance of the shell is smooth, but under a lens the sculpture



TEXT-FIG. 3.—*Parafossarulus sulcatus*, sp. nov. a, dorsal and ventral views of the holotype; b, c, the same views of the paratypes; d. outer and inner views of the operculum.

of the shell is seen to consist of very close and strongly impressed spiral striae. The first two whorls are smooth but the last two have the

sculpture strongly developed. Oblique longitudinal lines are present on the body-whorl, particularly near the margin of the outer lip. The interior of the mouth is smooth. The shell is hyaline and pale yellowish-brown in colour. The operculum is calcareous, oval, acute above and rounded below, concave on the outside and convex on the inner surface. The paucispiral figure is situated a little below the middle part, and is much less clearly visible on the inner than on the outer surface. The peripheral concentric lines are well developed. The edge of the operculum on the inner surface forms a narrow ridge to the periphery of the convex portion.

The radular teeth resemble those of *Bithynia (Alocinma) sistanica*, but the central is relatively broad, and has, as a rule, four latero-basal denticulations on each side, while the inner lateral has a comparatively long and broad ventral process projecting from below the cusps.

The male intromittent organ has a relatively stout spindle-shaped lateral process.

Measurements of type-specimens (in millimeters).

| <i>Locality.</i> | | | | | |
|------------------------|---|---|-----|-----|-----|
| Shores of lake, Lonton | . | . | 5.5 | 4.5 | 3.0 |
| Nyaungbin | . | . | 4.5 | 4.0 | 2.3 |
| | | | | | 2.0 |

Holotype.—M. $\frac{12845}{2}$ Zool. Surv. Ind. (*Ind. Mus.*).

Only six specimens were found in a living condition near Lonton and Nyaungbin on the western and northern shores of the lake respectively.

In form and sculpture, and in the characters of the radula and the male organ this species differs from other known species of *Parafossarulus* from Burma and China.

Family TIARIDAE (MELANIIDAE).

The genera common to many parts of India and Burma, namely *Acrostoma*, *Melanoides*, and *Paludomus*, are represented in the lake fauna by a few species, some of which are very widely distributed in the Oriental Region, and others are peculiar to Burma.

Genus *Acrostoma* Brot.

1928. *Acrostoma*, Rao, *Rec. Ind. Mus.*, XXX, p. 442.

Acrostoma baccata f. *lirata* Rao.

1928. *Acrostoma baccata* f. *lirata*, Rao, *op. cit.*, p. 445.

This form is represented in the lake fauna by a single incomplete shell collected by Mr. D. Mukerji from the southern shore of the lake near Lonton. The apical part of the shell is missing and there are only 3 whorls present. The mouth is shorter, relatively broad, and rounded at its anterior extremity. The shell is devoid of tubercles, but the ridges characteristic of this form are present on the lower part of the last whorl. The upper two whorls are comparatively smooth except for a shallow groove near the suture.

Acrostoma baccata and its forms in Burma are all inhabitants of streams in the uplands, chiefly in the Shan plateau.

The various parts of the lake were dredged by Dr. Chopra and his party but not a single specimen of this form was found in the bottom mud, which generally contained large numbers of shells of Viviparidae and Tiaridae. Its occurrence in the lake, therefore, is probably accidental. The shell found by Mr. Mukerji on the shore was presumably washed down into the lake from an adjoining stream during flood time.

This form is known only from Tangyan in the S. Hsemod State of the N. Shan States.

Genus *Melanoides* Brot.

1928. *Melanoides*, Annandale & Prashad, *Rec. Ind. Mus.*, XVIII, p. 21.

Melanoides tuberculatus (Muller).

1918. *Melania tuberculata*, Annandale, *Rec. Ind. Mus.*, XIV, p. 114, pl. xii, figs. 1, 2.
1928. *Melanoides tuberculatus*, Rao, *Rec. Ind. Mus.*, XXX, p. 448.

The species is very common on the shore and at the bottom of parts of the lake, and in small streams in the vicinity of Kamaing and Chaungwa. Specimens from the bottom of the lake were mostly dead, relatively narrow, and considerably eroded and bleached. Those from streams were all living but of small size, not exceeding 20 mm. in height and 10 mm. in breadth. They were black in colour with faint brownish marks on the body-whorl.

Melanoides scabra (Muller).

1844. *Melania (Plotia) scabra*, Nevill, *Handlist Moll. Ind. Mus.*, II, p. 281.
1915. *Tiara (Plotia) scabra*, Preston, *Faun. Brit. Ind. Freshw. Moll.*, p. 35.
1919. *Melania scabra*, Annandale, *Rec. Ind. Mus.*, XVI, p. 147, pl. v, fig. 6.

Several dead and worn shells of this species were dredged from the shallower parts of the lake near Lonton and Loimon. They are of small size, but the characteristic features of the species in form and sculpture are distinctly present. The distribution of this species in Burma is not fully known. The species does not occur in the Shan States, but it seems to have a fairly wide distribution in Lower Burma. The range of the species in the East is certainly wide, but in the Indian Empire it is somewhat restricted. The species has been recorded from the Bombay and Madras Presidencies, Lower Bengal, Assam, Burma and Ceylon.

Genus *Paludomus* Swainson.

1919. *Paludomus*, Annandale, *Rec. Ind. Mus.*, XVI, p. 147.

Though the number of species of this genus known from India, Burma and Ceylon is very large, the characters by which the species are distinguished from one another are not clearly understood. The species can presumably be assigned to a few sections or groups having certain distinguishing features in the operculum. The shell-form is

obviously an important character, and most of the well-defined species are based on this character. This is, however, difficult to make out in many species of the genus as the spire is in most instances worn, often up to the last whorl. Sculpture, texture, colour, and ornamentation are also characters used for the identification of the species, but these characters are often so very variable even in individuals of the same species that their reliability is open to question. Besides some species are liable to form local races which are often given specific rank. The anatomy of most, if not all, of the species is unknown, but so far as my knowledge of the anatomy goes, particularly of the radula, the mantle-edge and the gills of a few Indian and Burmese species, there is no diagnostic feature of value in these characters which will help in the identification of the species.

The genus as a whole stands in need of a thorough revision. Species of *Paludomus* have hitherto been found chiefly in Assam, Burma, South India and Ceylon.

Three species of *Paludomus* were found in the Indawgyi Valley. One is the common *P. regulata* of Burma and the other two are new to Science. The latter do not belong to the lake system or the valley. They were found in streams in the vicinity of Kamaing, about 50 miles north of the Indawgyi Lake.

I have thought it convenient to include in this paper the description of two more new species which do not belong to the lake fauna. Individuals of both these species are from Burma, presumably from the deltaic region of the Irrawady, and have been preserved in the Zoological Survey collection for many years without receiving a name. They are, however, related to other species dealt with in this paper.

***Paludomus regulata* Benson.**

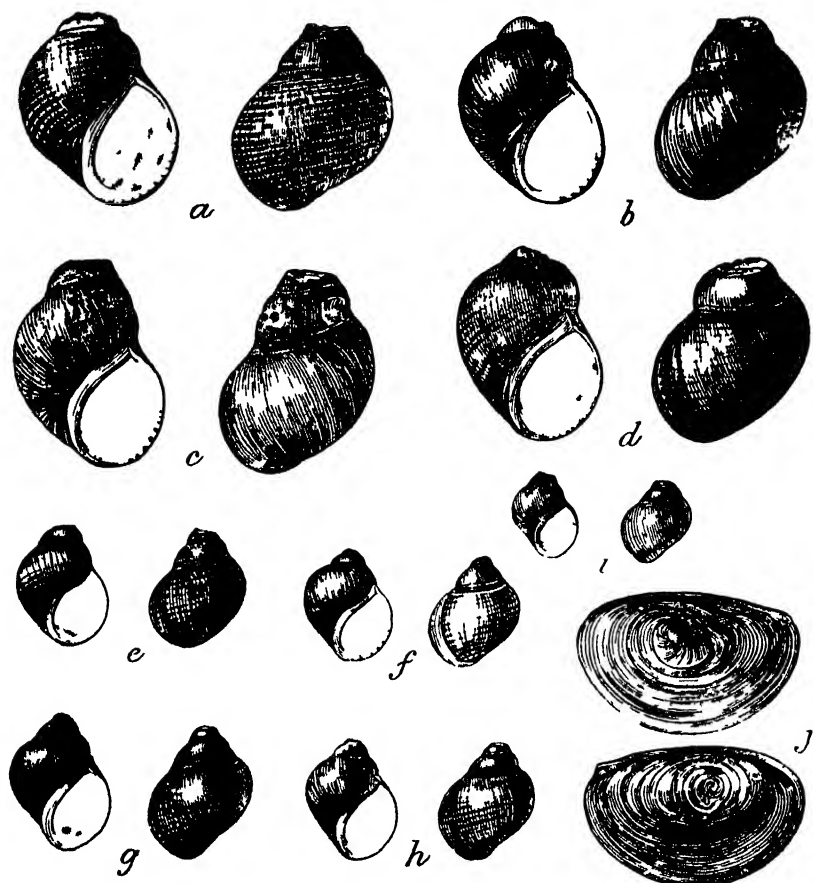
1928. *Paludomus regulata*, Rao, *Rec. Ind. Mus.*, XXX, p. 452.

Several individuals of this species were obtained in a living condition from streams and pools near Lonton and Loimon on the shores of the lake, and from rocky streams in the vicinity of Namma and Hopin. A few living specimens were also dredged from the shallower parts of the lake near Loimon.

***Paludomus crassicallosa*, sp. nov.**

The shell is conico-ovate, not much longer than broad, and is usually decollate, much more in the adult stage than in the young shells, which have as a rule 2-2½ whorls in the spire. The sculpture consists of rather ill-defined spiral ridges, which are obliterated in many shells, with the result that the shells appear to be smooth. The shells are, however, never absolutely smooth, a few ridges near the suture persisting in almost all the individuals. The spire is slightly oblique, minute and very little impressed. The aperture is slightly variable in form, being narrow in some and expanded in others. It is more or less regularly oval in form, acuminate above and rounded below. The columellar callus is relatively thick, convex, and somewhat reflected above with a very minute chink outside it in some individuals. It is broader and thinner

above than below. The interior of the mouth and the columellar callus have a bluish tint and are smooth and polished. There are not more



TEXT-FIG. 4.—*Paludomus crassicallosa*, sp. nov. *a* 1, dorsal and ventral views of shells of different sizes, *a*, represents the holotype, *i*, outer and inner views of the operculum

than four colour bands which are never continuous. They are broken up into a series of dashes or irregularly-shaped spots. These bands are not visible externally on the outside of the shell, except in younger individuals, in which a dark deposit has not begun to form. The colour of the shell is generally a dirty yellow, obscured by a thin black deposit.

Measurements in millimeters.

| Locality | Height of shell | Maximum breadth of shell | Height of aperture | Maximum breadth of aperture. |
|---------------------------|-----------------|--------------------------|--------------------|------------------------------|
| Rocky stream, Kamaing . . | 14.5 | 12.5 | 9.0 | 6.0 |
| Stream near Pandawmu cave | 14.0 | 12.0 | 8.2 | 5.2 |
| Kamaing-Jade Mines Road . | 13.5 | 12.0 | 9.0 | 5.5 |

Holotype.—M. ¹²³⁵¹/₂ Zool. Surv. Ind. (*Ind. Mus.*).

The holotype was obtained in Sankha, a large hill-stream between Kamaing and Mogaung.

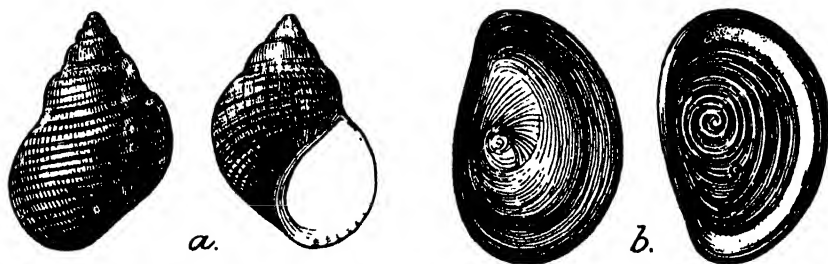
The radular teeth agree with the feature characteristic of the *Paludomus* type. The laterals and marginals are inclined at an angle of about 45° with the line connecting the bases of the teeth. The central has large cusps, the median being enlarged. The inner lateral tooth has also large cusps, but the 3rd or the 4th from the inner or axial side is much enlarged and squarish. The outer lateral has usually seven large and conical cusps. The marginal has numerous, elongate, narrow and sharp denticles on the margin which are usually about 18 in number. The short, broad-based conical process on the central is somewhat depressed in the middle.

Several hundred specimens of this species were obtained in the living condition from rocky or muddy streams within a radius of 10-15 miles from Kamaing.

This species seems to be closely related to *Paludomus nana* Nevill described below from Pegu in Lower Burma, but differs from the latter species in having a decollate spire and more convex body-whorl, in the more prominent sculpture, in the columellar callus being convex instead of sloping inwards, in colour, and in having interrupted colour bands.

***Paludomus kamaingia*, sp. nov.**

The shell is conico-ovate, of moderately small size, not exceeding 15 mm. in height, and is moderately thick. It has $6-6\frac{1}{2}$ whorls gradually increasing in size. The breadth of the spire at its base is a little more than half the breadth of the last whorl, and its height nearly half that of the entire shell. The whorls are moderately convex, and there is a slight shelf between successive whorls of the spire so that the outline of the shell is somewhat interrupted. The body-whorl in dorsal view is oblique, and below the middle on its left side is abruptly narrowed down. The suture is very minute and not impressed. The aperture



TEXT-FIG. 5.—*Paludomus kamaingia*, sp. nov. *a*, dorsal and ventral views of the holotype; *b*, outer and inner views of the operculum.

is oval, acuminate above and rounded below. The outer lip is relatively thin, crenulated as in most species of *Paludomus*,¹ and very slightly

¹ This crenulation seems to follow closely the contour of the mantle-edge and is doubtless the result of its activity.

depressed at its commencement above. The inner lip is relatively less arched. The columellar callus is well developed, rather thin at its junction with the apex of the aperture, relatively narrow, and flattened. It has a bluish tinge, and appears to be smooth to the naked eye, but is in reality minutely pitted or granular, and never conspicuously reflected, if at all. The interior of the mouth is smooth and shining. Three conspicuous but discontinuous brown bands are usually visible on the inner surface of the shell when the mouth is viewed. A fourth, which is sometimes clear, is found near the apex of the aperture close to the suture. These broken bands take the form of irregular dots or dashes. The sculpture consists of a number of spiral ridges, which are alternately broad and narrow. Immediately below the suture there are two or three much narrower but well-defined ridges. On the whorls of the spire and on the ventral side of the body-whorl the sculpture is somewhat feeble. Very minute longitudinal striae form the ground-work of the sculpture, but they can only be detected under the high power of the binocular microscope near the edge of the outer lip in adult shells or on the body-whorl in young individuals. The colour of the shell is yellow but is obscured by a black deposit which could not be removed except by prolonged treatment with a dilute solution of caustic potash.

The young shells are globular in form with the spire decollate. The sculpture is as prominent as in the adult, and the colour bands can be detected on the outside of the shell.

The operculum of the adult is narrowly ovate with its apex directed towards the columella; it is concave above and convex below. The paucispiral is clearly visible on both sides of the operculum with the nucleus situated near the columellar side and a little below the middle. Fine concentric lines are present outside the area occupied by the paucispiral. On the inner side the spiral is marked by well-defined ridges flanked by a smooth, broad ridge on the columellar side. The operculum is always covered on the outer surface by a firm, black deposit which can be removed by treatment with caustic potash and by scratching the surface with a fine scalpel or needle.

Measurements in millimeters.

| | Height of shell. | Breadth of shell. | Height of aperture. | Breadth of aperture. |
|----------|------------------------|-------------------------|---------------------------|----------------------------|
| Holotype | 15.0 | 11.0 | 8.5 | 5.5 |
| | 14.5 | 11.3 | 8.5 | 5.5 |
| | 14.2 | 10.5 | 8.0 | 5.0 |

Holotype.—M. $\frac{12851}{2}$ Zool. Surv. Ind. (*Ind. Mus.*).

The radular teeth closely resemble those of *P. crassicallosa* but are subject to slight variations in individuals.

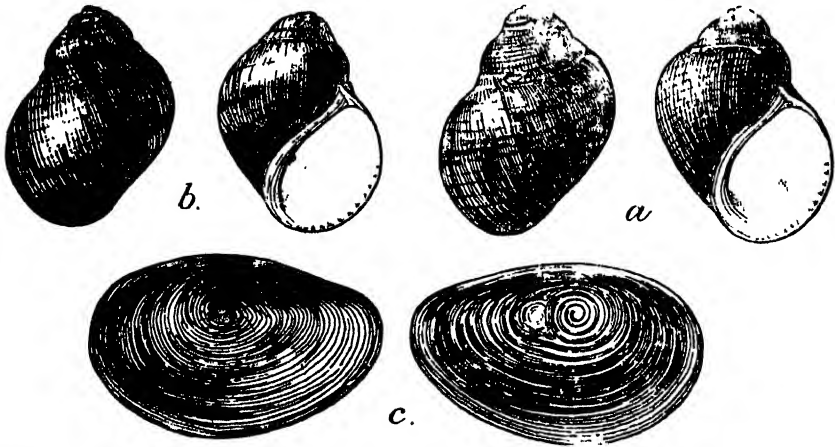
Several living specimens were collected from a small rocky stream near Kamaing.

The species is closely allied to *P. crassicallosa* but differs chiefly in the columellar callus not being convex, and in having a relatively prominent sculpture.

***Paludomus nana* Nevill.**

1881. *Paludomus andersoniana* subsp. *peguensis* subvar. *nana*, Nevill, *Journ. As. Soc. Bengal*, L, p. 160.

The shell is of moderately small size, the largest not exceeding 16 mm. in height and 12 mm. in breadth, ovate, and has 4-4½ moderately convex whorls which increase in size more or less rapidly. The spire is, as a rule, entire and rarely decollate, but the protoconch is scarcely, if ever, exerted, with the result that the apex of the spire is nearly always obtuse. The suture is transverse, distinct but lightly impressed. The body-whorl is about two-thirds as high as the shell, swollen and broadest in the middle. The aperture is ovate, acuminate above and relatively rounded below. The outer lip is thin and sharp and much more arched than the inner lip. The columellar callus is broad above and slightly narrow below towards the anterior end of the aperture. It is more or less flat and slopes down from the umbilical margin towards the interior of the mouth. No chink is left between the callus and the umbilical region. The callus is cream-white in colour, smooth and shining, but very minutely pitted. The sculpture is rather poorly developed, and there is a tendency for smoothness in the shells. Both longitudinal and spiral sculpture can, however, be easily made out with the help of a lens. The shell



TEXT-FIG. 6.—*Paludomus nana* Nevill. a, dorsal and ventral views of the holotype; b, the same views of another specimen; c, outer and inner views of the operculum.

is blackish or a dark brown in colour. Looking into the aperture four colour bands may usually be seen but these bands are subject to great variation. In young shells and in some adult ones traces of the colour bands are often present on the outside of the body-whorl. The operculum is thin, narrowly ovate, slightly depressed in the centre of the outer surface, and has no granular thickening in the centre of the inner surface. The paucispiral is visible from the inner surface also.

Measurements in millimeters.

| | Height of shell. | Breadth of shell. | Height of aperture. | Breadth of aperture. |
|----------|------------------------|-------------------------|---------------------------|----------------------------|
| Holotype | 14.5 | 11.5 | 10.0 | 6.0 |
| | 15.0 | 12.5 | 10.5 | 6.5 |
| | 16.2 | 13.0 | 10.0 | 7.0 |

Holotype.—M. $\frac{12847}{2}$ Zool. Surv. Ind. (*Ind. Mus.*).

Nothing is known about the anatomy. The shells have been cleaned and no trace of the animal is left behind.

A few shells of this species were collected by the late Dr. F. Stoliczka in Pegu in Lower Burma. Nevill considered them to be an undescribed variety of the subsp. *peguensis* of his species *Paludomus andersoniana*.¹ On careful comparison of the specimens catalogued by Nevill in his 'Hand-List' with *P. regulata* I find sufficient justification to give them a distinct specific status.

P. nana differs from *P. regulata* in several features but chiefly in the proportionately shorter and broader spire, in the relatively well-developed and somewhat flattened columellar callus, in the shell being comparatively thick, and in the operculum being devoid of a granular thickening in the centre of the inner surface. In sculpture and colour also the difference between the two species is apparent.

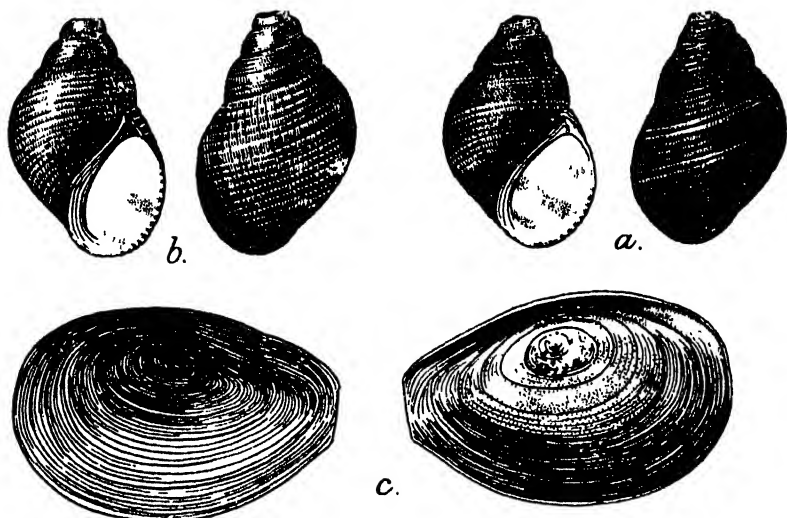
The Burmese species of *Paludomus* seem to have evolved from forms resembling *P. regulata* which is widely distributed in Burma. They seem to exhibit a certain degree of plasticity, and the differences in habitat have probably contributed their share to the factors operating on the evolution of various slightly differing forms from a common stock.

***Paludomus parvula*, sp. nov.**

The shell is regularly ovate or roughly elliptical, slightly decollate, and has only four whorls which are not at all swollen. The body-whorl is nearly as broad as high and two-thirds as high as the entire shell. The suture is oblique, well-defined and moderately impressed, and the outline of the shell is only slightly interrupted by the aperture. The aperture is elongate, oval, acuminate above and rather narrowly rounded below. The outer lip is thin and crenulated at its margin and is not very much arched, though more conspicuously than the inner lip. The columellar callus is flattened, fairly broad, of equal breadth throughout its entire length, and is continued to the anterior end of the aperture. The interior of the mouth is smooth, and has four broad bands, of which the third from above is the broadest. If the shell surface is without a black deposit these bands are also clearly visible on the outer surface of the body-whorl. The sculpture is very prominent and consists of broad spiral ridges separated by deep grooves. The ridge near the suture is

¹ In a previous paper on the Molluscs of the N. Shan States (*Rec. Ind. Mus.*, XXX, p. 452 1928) I have shown that Nevill's species is a synonym of *P. regulata* Benson.

particularly thickened. The ground sculpture consists of minute longitudinal striae visible on the ridges and in the grooves. The operculum



TEXT-FIG. 7.—*Paludomus parvula*, sp. nov. a, dorsal and ventral views of the holotype; b, the same views of another specimen; c, outer and inner views of the operculum.

is ovate, broadly pointed at apex, concave on the outer surface and convex on the inner. The paucispiral is visible from both surfaces, but the ridges of the nuclear part are very feebly developed on the inner surface. The concentric lines are minute.

Measurements in millimeters.

| | Height of shell. | Breadth of shell. | Height of aperture. | Breadth of aperture. |
|----------|------------------------|-------------------------|---------------------------|----------------------------|
| Holotype | 14.8 | 10.5 | 9.8 | 5.2 |
| | 15.5 | 11.0 | 9.5 | 5.5 |
| | 15.0 | 10.5 | 9.3 | 5.5 |

Holotype.—M. $\frac{12849}{2}$ Zool. Surv. Ind. (*Ind. Mus.*).

Only seven shells from an unknown locality in Burma are preserved in the Zoological Survey collection. They do not match with any known species from that country. They, however, resemble in external features only the Ceylonese *P. sulcata* var. *minor* Nevill. The operculum of the two species are so different that there can hardly be any specific relationship between them. From a label with the name *parvula* on it found along with the shells it seems possible that Benson intended to regard them as a new variety of *P. regulata*. I cannot find any reference to this name in literature, or any published figures with which the shells in question agree in every respect.

The radular teeth closely resemble those of *P. regulata*, particularly in having fewer denticles on the outer lateral and marginal teeth, and in the median cusp on the central not being conspicuously enlarged.

Family LIMNAEIDAE.

This family is represented by three species of which one is new to Science.

Only one species, *L. acuminata*, occurs in great abundance in the lake and its surroundings. Two specimens of another species, *L. luteola*, and a few of a new form of *L. acuminata* were also taken from the shores and shallow regions of the lake. The description of the new species is based on a single example from the lake.

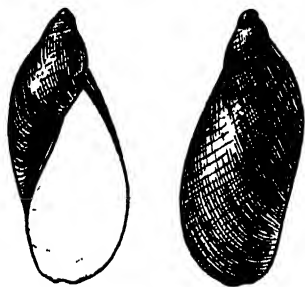
***Limnaea acuminata* f. *patula* Troschel.**

1925. *Limnaea acuminata* f. *patula*, Annandale & Rao, *Rec. Ind. Mus.*, XXVII, p. 181, fig. iii, 9, fig. vi, 1 & 2.

Several hundred specimens of this form in various stages of growth were taken in ponds and pools round about Lonton and Nyaungbin, and in the shallow parts of the lake near the shore in the vicinity of Lonton, Loimon, Nyaungbin and the Shwemyzu Pagoda.

***Limnaea acuminata* f. *pseudohorae*, nov.**

Though in size and sculpture this form approaches *L. horae* Annandale & Rao, it has, I think, no specific relationship with it. In the form of the shell and the spire, and in the nature of the columellar callus, which though very thin is always distinct, this form is undoubtedly closely allied to *L. acuminata*, particularly to the form *patula*, but in having minutely decussated longitudinal striae, which are so characteristic of *L. horae*, its resemblance to this species is remarkable.¹



TEXT-FIG. 8.—*Limnaea acuminata* f. *pseudohorae*, nov. Dorsal and ventral views of the holotype.

Holotype.—M. ¹²⁸⁵⁸ Zool. Surv. Ind. (*Ind. Mus.*).

Three fresh shells were taken along with *L. acuminata* f. *patula* from the shallow part of the lake near Shwemyzu Pagoda. The animals were unfortunately not preserved.

***Limnaea luteola* f. *australis* Annandale & Rao.**

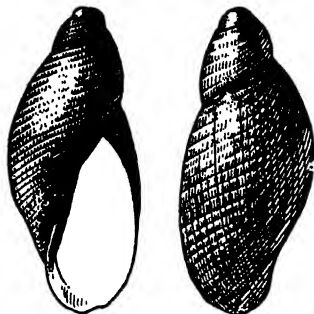
1925. *Limnaea luteola* f. *australis*, Annandale & Rao, *Rec. Ind. Mus.*, XXVII, p. 184.

This form is recorded for the first time from Burma. It has a wide distribution in India and Ceylon. The form *siamensis* Sowerby, which seems to be more or less in the nature of a local race of the species and known from the Shan States and the Irrawady delta, is curiously absent in the Indawgyi Valley and its neighbourhood.

Only two small living specimens were found sticking to aquatic weeds in a clear pool more or less connected with the Indawgyi Lake.

***Limnaea decussatula*, sp. nov.**

The shell is of small size and does not exceed 4 mm. in height and 2 mm. in breadth. It is elongate, narrowly elliptical, thin but not brittle, and consists of three whorls which are not at all swollen. The body whorl is large, and is about two-thirds the height of the entire shell. The apical whorl is small, knob-like, and is a little more than one-third the height of the penultimate whorl.



TEXT-FIG. 9.—*Limnaea decussatula*, sp. nov. Dorsal and ventral views of the holotype.

The suture is oblique and moderately impressed. The aperture is elongate, unusually narrow and compressed, but broadens out gradually from the posterior end to the anterior. The columella is well defined, but the callus is thin and poorly developed. It is somewhat twisted in appearance and forms a thin but conspicuous ridge along the greater portion of the periphery of the inner lip. The inside of the mouth is smooth and has an oily lustre. The outer lip is comparatively thin. The sculpture is very

minute and peculiar. The ground sculpture is longitudinal, but these longitudinal lines seem to be broken up later on into short decussating vertical but curved lines throughout the second and the last whorls. The concavity of these curved lines is always directed towards the columellar side. Parallel shallow grooves are formed between successive series of decussating lines and give the shell a spirally striated appearance. The apical whorl is smooth.

Holotype.—M. ¹²⁸⁵⁷₂ Zool. Surv. Ind. (*Ind. Mus.*).

The animal is only partially preserved, and I have not been able to study its anatomy.

A single example of this species was found along with specimens of *L. acuminata* f. *pseudohorae*, nov. in the shallow part of the lake near the Shwemyzu Pagoda.

The compressed nature of the shell and the aperture, the curious sculpture, and the columellar ridge mark this species as very distinct from any other Indian or Burmese lacustrine species of *Limnaea*. Though the species approaches *L. horae* in sculpture, it differs from it in having the mouth not at all expanded.

Family PLANORBIDAE.

In the fauna of the lake this family is fairly well represented by four genera and six species. Three of the six species have a wide distribution in the Oriental Region. *G. velifer* has hitherto been known from the Inle Lake, and its occurrence in the Indawgyi Lake seems to show that it is a purely lacustrine species. *G. rotula*, a rare Indian species, is recorded for the first time from Burma.

Indoplanorbis exustus (Deshayes).1928. *Indoplanorbis exustus*, Rao, *Rec. Ind. Mus.*, XXX, p. 457.

The species is very common in the Indawgyi Valley and the adjoining country. Several hundred specimens, living and dead, were taken in ponds near the lake at Lonton and Hopin and near Kamaing. Some of them are of large size. Those collected near the north end of the lake contain a large number of small and young specimens.

Gyraulus velifer (Annandale).1918 *Planorbis velifer*, Annandale, *Rec. Ind. Mus.*, XIV, p. 112, pl. xi, figs. 7-11.

In the shallow parts of the lake near Lonton and the Shwemyzu Pagoda this species is very common. Several living specimens were collected at these places, some of them from the latter locality being particularly large. The velum is well developed in all specimens. The species has hitherto been known only from the Inle Lake in the S. Shan States. In that lake it is common amongst dense masses of aquatic weeds.

Gyraulus velifer var. **ciliata** (Annandale).1918. *Planorbis velifer* var. *ciliata*, Annandale, *op. cit.*, p. 112.

Several examples of this variety were taken along with the typical species mostly in the living condition. They seem to stray occasionally into the deeper parts of the lake. The spiral ridges characteristic of this variety vary in number, but are more numerous than in the specimens from the Inle Lake.

Gyraulus convexiusculus (Hutton).1928. *Gyraulus convexiusculus*, Rao, *op. cit.*, p. 457.

The species is common in the shallow parts of the lake near Lonton and Nyaungbin. Large numbers of specimens were found in weedy ponds round about Lonton, and amongst submerged floating weeds near the shore of the lake at Nyaungbin.

Gyraulus rotula (Benson).1850. *Planorbis rotula*, Benson, *Ann. Mag. Nat. Hist.*, Ser. 2, V, p. 351.1876. *Planorbis rotula*, Hanley & Theobald, *Couch. Ind.*, p. 40, pl. xcix, figs. 2 & 3.

With some hesitation I refer to this species two shells from the shores of the lake near Lonton. They are not quite fresh, and the mouth of the shells is not entire. The sculpture is somewhat coarse and there is no trace of the spiral striae referred to in Benson's original description. The whorls are uniformly convex, and the mouth is small and rounded. The apex is relatively depressed. In the number and general features of the whorls, the shells agree with the description of *G. rotula*.

Shells from Bombay in the collection of the Zoological Survey of India referred to by Nevill (*Hand-List Moll. Ind. Mus.*, I, p. 245) as "*Planorbis (Nautilina) rotula* (?)" are included by Germain in *G. rotula*

(Benson).¹ I have examined the full-grown shells in this lot and find that they are in no way related to *G. rotula*. In the departure of the last whorl from the axis of the inner whorls and in the presence of a whitish rib within the lip, the shells under discussion agree very well with *G. labiatus* (Benson).

Benson, who first discovered the species at Moradabad as early as 1841, regarded it as a rare species, and this is borne out by the fact that there has been no record of the species since then from any other part of India. Drs. Prashad and Hora, however, rediscovered the species in 1920 in a pond in Moradabad, but unfortunately their collection consists of only one small shell, which agrees very well with Benson's description of the species.

Dr. Prashad² has referred to this species shells from Ceylon described by Westerlund as *Planorbis (Gyraulus) liratus*. His figure of the species compared with the specimen from Moradabad indicates that the Ceylon specimens are identical with *G. rotula*.

The anatomy of the species is totally unknown. Benson has referred to the peculiar mode of progression of this species. I have observed *G. convexiusculus* and *G. euphraticus* in their natural environment perform occasional jerky movements of the shell when suspended from the surface film, but they did not move very far from their original position. The rapid progression of *G. rotula* by sudden jerks is presumably a unique character.

From the little known records of the species, e.g., from the Indawgyi Lake in Upper Burma, from Moradabad in N. India, and from Ceylon in the extreme south, it is only possible to surmise that its distribution is discontinuous.

Segmentina calathus (Benson).

1921. *Segmentina calathus*, Annandale & Prashad, *Rec. Ind. Mus.*, XXII, p. 585.

This species is apparently rare both in the lake and in the streams and pools in the valley and in the plains north of the lake. Only one young example in a dead condition was found along with other species of Planorbidae from the shores of the lake near Lonton. The mouth is not entire, and the whorls are comparatively broad in dorsal view. The internal partitions in the shell, two of them at any rate, are quite distinct though relatively thin.

The species is common in Northern India, Burma and Ceylon. Its range outside India extends up to Seistan in the North-west and up to Siam and Sumatra in the East and South-east.

Hippeutis sp.

Six small dead shells dredged from the south end of the Indawgyi Lake near Lonton are referred to this genus. With some of the generic characters of *Hippeutis*, e.g., the tentacular shape, the convex dorsal and flattened ventral surfaces, and the deep umbilicus, the shells

¹ Germain, *Rec. Ind. Mus.*, XXI, p. 128 (1922).

² Prashad, *Rec. Ind. Mus.*, XXVII, p. 347 (1925).

agree closely, but differ in being greatly depressed and in the rapidly increasing size of the whorls. With only a few dead and much worn shells it is impossible to be certain about its specific identity.

The shells are whitish in colour and have well-defined, impressed, oblique, longitudinal striae. The periphery is carinate, and in one shell it carries a pair of bacterial vela, one below the other, the lower being more prominent than the upper. The aperture is heart-shaped.

Family SUCCINEIDAE.

This family is very poorly represented in the Indawgyi Valley, the only record being a form of the species *Succinea gravelyi* Rao.

Succinea gravelyi f. *deccanensis* Rao.

1924. *Succinea gravelyi* f. *deccanensis*, Rao, *Rec. Ind. Mus.*, XXVI, p. 403.

A single example in the living state was found at the edge of a stream near Lonton. Unfortunately the animal is in a bad state of preservation, and I am, therefore, unable to verify my identification by an examination of the internal organs, except the radular teeth, which agree closely with those of *S. gravelyi*. The shell is smaller than any of the typical specimens from India, and is somewhat abruptly narrowed from the middle. The last whorl is not evenly arched in dorsal view. The sculpture is coarse and consists of irregular longitudinal striae.

Succinea gravelyi, like *S. daucina* and *S. godivariana*, seems to have a restricted distribution in India and Burma.

CORALS OF THE GENUS *FLABELLUM* FROM THE INDIAN OCEAN.

By J. STANLEY GARDINER, M.A., F.R.S., Professor of Zoology and Comparative Anatomy, University of Cambridge.

(Plate XIII.)

Twenty years ago I received a number of specimens of Corals of the genus *Flabellum* from the Indian Museum, Calcutta. I compared them with specimens in the British Museum and in the Smithsonian Institute; Drs. Wayland Vaughan and Von Marenzeller as well as Dr. Alcock allowed me to consult with them as to the validity of the species. My report was drawn up, but the difficulties of the war and subsequent years delayed further action. I have now re-examined the collection and also the British Museum specimens, and I have to express my thanks to the late Professor Jeffrey Bell and to Captain Totton in respect to the latter.

The genus is almost cosmopolitan with its centre, as shown by variety of species and the numbers of specimens obtained, in the East Indies, especially in the Philippines. It occurs sparingly in the Atlantic, but Duchaissaing and Michelotti, Pourtalés and Vaughan do not mention it from the West Indies. So far as we can judge it is essentially a species of the higher land slopes, but several species are recorded down to 1,000 fms., 1,500 fms. being its present maximum depth. It has lived from the Eocene, in which there would appear to have been more species than to-day. There are plenty of varietal forms of each species, for their growth, as is that of all attached forms, is greatly influenced by the movements of the surrounding water and the consequent scouring, and by the rate of deposition of deposits. The outer wall is an epitheca, not covered by tissue, and it may be dissolved or abraded away by water movements, or rasped off by sea urchins and other organisms; the consequent reaction is seen in that the polyp deposits fresh corallum between the septal ends against this destruction, and the whole calicle becomes relatively dense and heavy. This pathological condition often results in seeming costae, whereas true costae cannot exist with an epithecate wall. These false costae are sometimes the now free outer edges of the septa, but as frequently this is reversed and the secondary corallum forms a convexity or ridge between the septa, the destruction of which has gone deeper.

Modern investigators have tended to restrict severely the number of species. They demand a suite of specimens, and they base their views on various measurements and on their correlation with each other and with counts of the septa of various sizes and the numbers of the same joined by trabeculae in a columella. These are all very well, but it has to be recognised that any character, such as teeth on the septal edges or even so minute as spines on the growth lines of the septa is sufficient if constant. However, marked septal teeth are

unusual in the genus and such of the latter characters, as are visible without sections of the septa, are so fluctuating that they must be assumed to be correlated with environment. Furthermore, the polyps of many forms of *F. rubrum* (or possibly of several species of this type of growth) exhibit practically no variation either in their gross anatomy or in their minute histology. In this connection the opinions of Vaughan are of especial value, for he has studied the range of both living and fossil species, and I am in essential agreement.

The method of reproduction of *Flabellum* is by internal fertilisation and the extrusion of planulae. The young coral is always attached by a narrow base, but the very old coral is nearly always freed either by breaking away or by the solution or destruction of its base of attachment. In some cases, especially of the *rubrum*-type of growth, there is a distinct scar left in which the septa are clearly visible though their interspaces are usually filled by secondary corallum. This suggests "multiplying asexually by transverse division from a fixed nurse stock" and a comparison with the method of reproduction of *Fungia*. It is difficult to imagine a withdrawal of the tissues in this rupture, the calicoblastic ectoderm being so closely attached to the corallum, but as any part of the polyp, if broken into, can form a cup, which will grow up into a fresh corallum, it seems reasonable to suppose that such a sexual reproduction can take place. Furthermore, I have examined specimens, evidently very recently detached and without corallum between the septa of the scar, the tissues of which showed rupture. Yet, in over 1,000 specimens examined, I have found no calicle that I can suggest to have been so formed from "a fixed nurse stock," and I can only ask future collectors to look out for such. In this connection I may mention that in a suite of 6 specimens of *Blastotrochus nutrix* Ed. and H. in the British Museum, so identified by Bruggemann, I discovered that most show traces of splitting or imperfect formation of corallum with bud formation at the sharp lateral edges of their flattened calices. I suggest that the polyps of this genus—and also of *Rhizotrochus*—must be properly examined before its proposed absorption into *Flabellum*, based on corallum alone, can be accepted.

Most of Milne Edwards and Haime's species of *Flabellum* fall under two types of growth represented by the species *rubrum* Q. & G. and *pavoninum* Lesson. A third type is represented by *F. japonicum* Moseley, *F. alabastrum* Moseley and *F. deludens* von Marenzeller and yet a fourth by *F. curvatum* Moseley and *F. multifore* Gardiner. All are represented in Indian Seas.

***Flabellum pavoninum* Lesson.**

(For literature and synonymy see Gardiner, *Marine Invest. in S. Africa*, II, p. 123, 1902; Vaughan, *Bull. U. S. Nat. Mus.*, LIX, p. 49, pl. i-iii; and Faustino, *Monograph Bureau of Science, Manila*, XXII, p. 43, 1927.)

I have seen a large number of specimens of this species including those in the U. S. National Museum which Vaughan described. I accept Vaughan's synonymy, but I do not agree that the species "can best be handled" by recognising varietal forms. I do not think they represent any elements in heredity, basing my views on my failure

to find any distinctions in the gross anatomy (polyp and corallum) of three of these "varieties" after my return from Washington in 1909.¹ I consider all to be growth-forms produced by environment, the chief variations of importance in which I deem to be (1) sedimentation, (2) food, (3) water movements and (4) depth and temperature, in this order—and I think that the localities from which specimens have been obtained supports this conclusion.

Yet, it is necessary to recognise that this may be an error and that we are dealing with several species overlapping in the appearances of their calices, distinguishable only by their polyp characters. This remark applies particularly to the typical form, var. *distinctum* Ed. and H., and var. *paripavoninum* Alcock, which are mainly separable by the angles of divergence of the lateral ends of their compressed coralla. The original type of Alcock's *paripavoninum* (*Madreporaria of the Investigator*, p. 21, pl. ii, fig. 3, 1898) is interesting in that it is a specimen which has been broken off its pedicle, in the scar 24 septa being distinguishable of which half meet in a pseudo-columella.² My doubt lies in the fact that Vaughan had a considerable suite of specimens of all three from the Hawaiian Island and Laysan, and Faustino of the first and last from the Philippines, apparently with very few intermediates. The special localities given show a wide range of depth and hence temperature, and in consequence the angles of the lateral edges of the *pavoninum* forms could only be correlated with sedimentation in respect to which we have no information.

Localities : (a) ZEV $\frac{185}{7}$, Sta. 239, 11° 49' 30" N., 92° 55' E., 55 fms., 9 specimens, 5 damaged, all rather dark coloured, bluish, shiny, shapes transitional between Vaughan's typical form up to his form *distinctum* (*loc. cit.*, pl. ii, figs. 3-5), size about the same : (b) $\frac{3268}{9}$, 6° 1' N., 81° 16' E., 34 fms., a single dead specimen, recently broken off its pedicle, with some *Li'holthamnus* growing on its outsides, colourless corallum, near *distinctum*-form : (c) ZEV $\frac{1887}{7}$, Sta. 237, 13° 17' N., 93° 7' E., 90 fms., one specimen, dead, calice 31 mm. long by 19 mm. high, transition type to *distinctum*-form ; (d) ZEV $\frac{774.7}{7}$, Sta. 246, 11° 14' 30" N., 74° 57' 15" E., a single specimen, dead, calice 25 mm. long by 21 mm. high, shape towards *latum*-form : (e) ZEV $\frac{5322}{7}$, Andamans, 53 fms., a single living specimen of dark colour, calice 26 mm. long by 28 mm. high, very low arch to calicular margin, fairly compressed, slight wings on lower part, rather constricted just below calicular opening, a pathological specimen of *distinctum*-type : (f) ZEV $\frac{5324}{4}$, Sta. 389, 9° 1' 50" N., 75° 55' 50" E., 81 fms., 2 specimens—no. 1, dead, colour dark, calice 44 mm. long, 24 mm. wide, edge slightly ingrowing above, arch considerable, 24 mm. high, broken off from pedicle, scar 8 by 5 mm., whole corallum heavy and close to original *paripavoninum*-form ;—no. 2, also dead but cleaner, colourless, calice 42 mm. long, 23 mm. wide, rounded ends and no trace of wings, arch low, 42 mm. high, whole corallum very coarse,

¹ The polyps were examined by sections ; they were sufficient up to the point where histological study commences.

² There is an excellent specimen close to Vaughan's var *latum* Studer in the Cambridge Museum with a similar but much larger scar.

especially columella, considerably eaten into at base between the septa with extra deposition of corallum inside, comparable to Vaughan's pl. ii, fig. 1: (g) ZEV $\frac{1250-1}{7}$, Sta. 277, 5° 48' 15" N., 80° 56' E., 859-880 fms., alive when obtained but broken in dredge, remarkably similar to last but a rather smaller specimen.

To the above localities must be added Alcock's *paripavoninum*-form ("Investigator" Deep Sea Madreporaria, p. 21, pl. ii, figs. 3, a, b, 1898), a dead specimen off Pedro Bank, Laccadive Sea, 636 fms., admirably figured, scar 7 × 5 mm., not looking like an "accident" but rather a cutting off as in *Flabellum rubrum*, this remark also applying to (f, no. 1) above.

The "Sealark" collections contain specimens from Saya de Malha: C 4, 125 fms., 3; C 5, 125 fms., one much overgrown by "oysters"; C 6, 145 fms., 5 specimens, one broken off its attachment and showing in scar 24 septa joining in a columella. They approximate in size to the smaller S. African forms. All were dead, apparently recently killed, and white. Their septal edges are pleated and sides spiny. They belong either to Vaughan's *distinctum*-form or are intermediate between this and the typical. They come off a smooth sandy (glob. ooze) bottom.

The specimens described by Marenzeller as *Flabellum stabile* from Cape Verde Islands, 1694 metres (*Steinkorallen, Valdivia Exped.*, p. 273, pl. xvii, fig. 12, 1904) are certainly not widely separated from specimens (f, no. 2) and (g) above as well as from Vaughan's pathological specimen (pl. ii, fig. 1). I can find no evidence that Marenzeller has examined any considerable suite of *pavoninum* and I am disposed to think that his *F. stabile* as well as his *F. chunii* are synonyms of *F. pavoninum*.

F. campanulatum Holdsworth (*Proc. Zool. Soc.*, 1862, p. 198) from the Philippines may belong here, but the type specimens are not in the Museum of the Royal College of Surgeons, nor are there labelled specimens in the British Museum. Faustino suggested a re-examination, but, in the absence of types and of sufficient description, the species had better disappear from literature. I suggest the same course in respect to *F. nobile* Holdsworth as founded on dead material through the specimens still exist in the College.

Flabellum multifore Gardiner.

Gardiner, *Fauna Geogr. Maldives and Laccadives*, p. 954, pl. xciii, figs. 28 and 29, 1905; Faustino, *Monograph Bureau of Science, Manila*, XXII, p. 57, 1927.

In addition to my suite of specimens from the Maldives, 24-28 fms., the "Sealark" obtained 1 specimen from Seychelles, F 7, 34 fms. When alive the polyp was green standing up on the corallum for over 2 cm. The calicle was 53 × 17 mm., rather pinched in the central part, vertical height at sides 34 mm. and at ends 15 mm. above its attachment, growth rings 6, septa 180, one stomodoeum. It is of rather less coarse growth than the Maldivian specimens.

Faustino had a suite of 15 specimens from the Philippines from 97 fms. His largest specimen is about the size of my largest specimen and is stated to have over 800 septa, whereas mine has only 302; surely a clerical error in the doubling of his numbers has crept in.

There are three well figured "Challenger" specimens of *F. curvatum* Moseley from the Rio de la Plata region, 600 fms.; they clearly belong to the same species group of the genus.

***Flabellum deludens* Marenzeller.**

F. laciniatum, Alcock, "Investigator" Deep Sea Madreporaria, p. 21, pl. ii, fig. 4, a, 1898.

F. deludens, Marenzeller, Steinkorallen "Valdivia" Exped., p. 269, pl. xvii, fig. 10, 1904.

F. deludens, Vaughan, Bull. U. S. Nat. Mus., LIX, p. 63, pl. iii, figs. 5, a-b, 1907.

The specific name *laciniatum* should disappear from literature as the material on which the species was founded by Philippi was too fragmentary for positive identification. I have compared the specimens with the British Museum specimens of *F. alabastrum* Moseley and I agree with Vaughan as to the distinctness of this species. The shapes of the coralla looked at from the side vary in a parallel way to Vaughan's *pavoninum*-form from *lamellulosum* through the typical to the *distinctum*-form. They have a tendency to be widely open in their transverse diameter, looking into the calicles, but their ends are sharp.

Localities.—(a) ZEV $\frac{1431}{7}$, Sta. 280, 11° 29' 45" N., 80° 2' 30" E., 446 fms., two dark coloured specimens, largest length of calice 44 mm., breadth 34 mm., height 34 mm. : (b) ZEV $\frac{5334}{7}$, Sta. 392, 8° 43' 30" N., 76° E., 400 fms., two rather smaller and very delicate white specimens, apparently living when obtained : (c) spirit specimen ZEV $\frac{2105}{7}$, Sta. 322, 11° 26' 30" N., 92° 53' 45" E., 378 fms., a young specimen.

Alcock calls this species "a common inhabitant" of Indian Seas at 400—600 fms. The "Sealark" obtained two specimens from Saya de Malha : C 20, 300-500 fms., and C 4, 125 fms. The first specimen is 24 mm. along the base and the wings extend below the pedicle ; the height is 34 mm. In the species it occupies about the same position as the *lamellulosum*-form in *F. pavoninum*.

Other records are west of Sumatra, 614 and 660 metres (Marenzeller), Hawaii, 670-900 fms. (Vaughan). Faustino had a suite of specimens from 24 stations near the Philippines, 19 to 502 fms. ; he is evidently doubtful whether the species is not a synonym of *japonicum* Moseley which is not naturally a compressed species with sharp angles as this species almost universally is, in at least the young forms. I also found an unnamed specimen from Japan in the British Museum.

In the British Museum I have seen certain specimens labelled *F. laciniatum* reputed to be those of Duncan (*Trans. Zool. Soc.*, VIII, p. 322, 1873) ; they are not this species, which so far has not been found in the Atlantic.

F. alabastrum Moseley = *F. goodei* Verrill would seem to be related here, but it has not been obtained from Indian Seas. Vaughan mentions a suite of 170 specimens in the U. S. National Museum some of which I have seen. Young forms might be confused, but mature forms do not intergrade.¹

¹ See also Vaughan, Bull. U. S. Nat. Mus., LIX, p. 64, 1907.

Flabellum japonicum Moseley.

(Plate XIV, figs 1—6.)

Flabellum japonicum, Moseley, *Deep-Sea Madreporaria* ('Challenger'), p. 168, pl. vii, fig. 3, a, 1881; Wood-Mason & Alcock, *Ann. Mag. Nat. Hist.* (6) VIII, p. 449 1891; Alcock, "Investigator" *Deep-Sea Madreporaria*, p. 23, 1898, and 'Siboga' *Exped.*, p. 32, 1902.

Flabellum angulare, Moseley, *Deep-Sea Madreporaria* ('Challenger'), p. 164, pl. vi, fig. 2, a, b; *F. apertum*, Moseley, l. c., p. 167, pl. vi, fig. 7, a, c.; *F. conuis*, Moseley, l. c., p. 165, pl. vii, fig. 6, a, b, 1881.

The 8 'Challenger' specimens of Moseley's *F. apertum* were all dead when obtained and partially decomposed, perhaps with extra lime deposits from the surrounding water on the corallium, giving a peculiar opaque appearance. The 'Challenger' figure on p. 168 is $1\frac{1}{2}$ times natural size, and is the largest specimen of station 145. All the drawings are accurate in respect to numbers of septa but bad. The specimens from station 3 are negligible being too much decomposed for identification. They are clearly referable to *japonicum*, the very delicate septa of cycle V having usually been destroyed in most systems.

There is no doubt that the younger specimens under consideration are indistinguishable from the single form described by Moseley as *F. angulare* as direct comparison showed them to be similar in all respects but hexameral instead of pentameral.

The single 'Challenger' specimen of Moseley's *conuis* is alike in all respects to similarly fast-grown specimens of *japonicum* of about the same size such as (d) mentioned below. The latter is rather more open, viz., less conical, than the type and it has the same 4 cycles of septa. There are indications of wrinkling in the septal sides of this and many forms but in no case so marked as in Moseley's specimens; this character becomes progressively less marked with the thickening of septa which takes place as the growth attains its maximum.

The present specimens might be described under any of the above names, but they are still more clearly referable to *japonicum* of which there are a series of forms with a correct figure and a good description. I should not term the types wedge-shaped and the description of an "opaque white epitheca etc.," is incorrect, the appearance described being due to the decay of the epitheca, which stands up as a "glistening and polished" wall above. Only 4 of the supposed 8 'Challenger' specimens could be found (1929). I note a few points of difference from the suite of specimens before me:—

- (a) The transverse section of the corallum of any level varies from round to oval and nowhere can be termed "wedge-shaped."
- (b) The septal ridges, so-called 'costae' of Moseley, are not well-marked in the "Challenger" specimens that I have seen, though they are clearly shown in the figured specimen; the present specimens generally, if undamaged externally, have 12 marked ridges essentially similar to those shown in the figure.
- (c) Most of the present specimens are not much corroded, but two have lost nearly all their ribs, for the corrosion particularly takes place outside, on the lines where the septa run into

the epitheca, in some cases the septal ridges being even replaced by grooves.

- (d) The centre of the corallum is filled in to a very varying degree in different specimens by false columellar corallum, varying from fused thickenings of septal sides and ends to masses of anastomosing trabeculae of varying coarseness. The adjective "fascicular" used by Moseley can scarcely be applied even to the 'Challenger' specimens.
- (e) The present specimens in spirit showed tentacles over all the septa, but in only one specimen can all the tentacles over each cycle of septa be recognised. Usually the tentacles over the septa of cycle V are most clearly seen, being most external and the last to contract, and then progressively those over cycles IV, III, II and I. Each tentacle ends in a white knob.

In all other respects the present specimens agree with Moseley's type, and of the above points (a—d) are of little specific importance, being easily explicable. The difference noted under (e) may be due to different methods of preservation being employed but Moseley's fig. 12 on pl. xvi is a bad diagram.

The type of *F. conuis* Moseley has likewise 4 cycles of septa.

Localities.—(a) ZEV $\frac{5335}{7}$, Sta. 242, 17° 27' N., 71° 41' E., 56-58 fms., one specimen, measuring length \times breadth of calice, 60 \times 46 mm., \times vertical height of corallum, \times 53 mm., outside considerably corroded and no marked septal ridges, no columellar tissue; (b) ZEV $\frac{2162}{7}$, Sta. 321, 5° 4' 5" N., 80° 22' E., 660 fms., one, 51 \times 37 \times 29 mm., rather a wide open form, little corroded, septal ridges well marked, thick anastomosing trabeculae from septal edges forming a conspicuous false columella; (c) ZEV $\frac{1238-45}{7}$, Sta. 275, 8° 27' N., 75° 35' E., 771-731 fms., 6 specimens measuring 52 \times 42 \times 32 mm., 43 \times 33 \times 30 mm., 31 \times 28 \times 15 mm.; 24 \times 23 \times 13 mm., 29 \times 26 \times 17 mm., and 26 \times 23 \times 15 mm., all with septal ridges, smaller specimens four cycles of septa and shape approaching *F. apertum* Moseley in side view—last two specimens dead when obtained, corallum opaque and appearing thickened, giving a still closer resemblance to the same species—columella various, first specimen merely thickened edges of septa fused; (d) ZEV $\frac{772}{7}$, Sta. 256, 7° 58' N., 79° 23' E., 937 fms., one, 35 \times 31 \times 22 mm., general resemblance to *F. conuis* Moseley in all respects except that it is lower and therefore appears more open; (e) ZEV $\frac{1248-9}{7}$, Sta. 273, 12° 47' N., 73° 44' 45" E., 870-823 fms., two, 47 \times 40 \times 35 and 17 \times 13 \times 14 mm., larger specimen much corroded as (a) above and no septal ridges, smaller specimen showing a tentacle over each septum; (f) ZEV $\frac{1751-5}{7}$, Sta. 306, 9° 20' N., 75° 24' E., 930 fms., five, measuring 37 \times 30 \times 25 mm., 25 \times 21 \times 16 mm., 17 \times 12 \times 10 mm., 18 \times 17 \times 9 mm., and 18 \times 15 \times 7 mm., last two specimens showing septal cycles I and II markedly distinct; (g) ZEV $\frac{1757-60}{7}$, Sta. 307, 7° 28' 30" N., 76° 26' 30" E., 888 fms., four, 41 \times 35 \times 27 mm., 36 \times 31 \times 22 mm., 33 \times 27 \times 25 mm., and 22 \times 23 \times 22 mm.,

The depth range of the species is from 56 to 1250 fms., the latter *F. angulare* Moseley, 'Challenger' specimen. This latter is the only certain record from the Atlantic, having been obtained off Nova Scotia. The species appears to be common in Indian Seas and probably ranges widely in the Indian and W. Pacific Oceans.

Note on a polyp:—The smallest specimen from (g) above was cut into sections. It had 12 large septa (cycles I and II), trabeculae from which shared in the formation of the columella, and 12 further conspicuously thick and broad septa (cycle III); there were only traces in low ridges of septa cycle IV. The two pairs of directive mesenteries are well marked and the first 24 septa are all entocoelic; as yet there is no formation of any further mesenteries, but these may form subsequently as the sections reveal the fact that the 12 septa of the second size are visible in the sections below their bounding mesenteries. I think all these mesenteries reach the stomodaeum. There are tentacles over all the septa, but those over the first 12 septa are so tightly pulled down as to be only recognisable by their batteries of nematocysts. The tentacles over the next 12 septa are partially invaginated and there are indications in nematocyst batteries of a further cycle of tentacles. The stomodaeum is so pulled out that it is difficult to see where the peristome merges into the stomodaeum and the latter into the filaments, all three parts having the same histological elements. The mesenterial filaments have fewer nematocysts than usual and their lower ends are not free or extrusible as acontia. There is indication of a good miscellaneous diet, as seen by sponge and other spicules and chitin remains. Ova occur very low down in a few of the primary mesenteries, and there are a few free eggs and planulae in the coelenteron.

Allied to this species is Moseley's 'Challenger' *F. patagonicum* which has not since been recorded. Few of the type-specimens are larger than the smallest of the present series of *japonicum*; their growth is more cup-like. The edges all show some scalloping between the tops of the septa. Four cycles of septa is a definite character and at present must be so regarded and not a size matter. More important is the tooth-ing of the septal edges especially where they fall to the columella. The ridges and granules on the septal sides are much more marked than in *F. japonicum*. At present the species must be regarded as good, but may conceivably prove to be a growth-form of *F. japonicum*.

Flabellum rubrum Q. et G.

F. rubrum, Gardiner, *Marine Investigations S. Africa*, II, pp. 125-52, pls. i-iv, 1902; Harrison & Poole, *Proc. Zool. Soc.*, 1909, p. 899.

For *F. stokesi*, Ed. et H., *vide* Gardiner, *l. c.*, p. 131; also Alcock, *Journ. As. Soc. Bengal*, LXII, p. 138, 1893.

F. crassum et rubrum, Bourne, *Report Pearl Oyster Fisheries, Ceylon*, pp. 196-200, 1905.

I don't think there is any use in my dealing with Bourne's attack on, and misrepresentation of, the methods adopted in my paper cited above; Bourne dealt with 5 specimens only, while I had actually examined over 700 specimens which he could have examined. I hesitated to regard *stokesi* as a synonym of *rubrum*, and the collection before me

is not sufficiently large to cause me to alter my position, although I could not find any differences in the polyps of the two "species."

In 1898, in 1901 and again in the present year I examined the British Museum collection which contains 41 items, 120 specimens, of the growth-form of *rubrum*—*stokesi*. Bruggemann identified these with the species *stokesi* E. & H., *rubrum* Q. & G., *elongatum* E. & H., *spheniscus* Dana, *aculeatum* E. & H., *debile* E. & H., *crassum* E. & H., *bairdi* E. & H., *profundum* E. & H., *crenulatum* E. & H., *candeanum* E. & H., *spinosum* E. & H., *elegans* E. & H., while he evidently intended to describe six new species to which he gave the names *amethystinum* (whole corallum of a beautiful strong amethyst colour), *lewisi*, *ayleni*, *belcheri*, *laeviusculum* and *angustum*. Among the specimens are forms from New Zealand whence came the original types of Quoy and Gaimard. Seven of the above "species" were represented in Capt. Sir Edward Belcher's collection from Malacca. Apparently Bruggemann considered *affine* E. & H. = *spheniscus* Dana as he labelled some of the latter "types of *F. affine*," "types" being used as meaning typical. I do not agree with Bruggemann's views as indicated above, but I have pleasure in recording them as they are always worthy of careful consideration.¹

Of the British Museum specimens 26 coralla in form approach *stokesi*, 66 *rubrum* and 15 are doubtful; 13 young or attached forms are omitted. The present collection contains 20 specimens from 7 localities. Of these most approach *stokesi* in mode of growth, wings or processes from side of corallum, size of scar, etc. Superficially, they can be roughly divided between *rubrum* and *stokesi*, but the more carefully they are examined the more difficult the division becomes. I have searched for and cannot find differences in the characters Bourne suggests (*loc. cit.*, p. 200) and I have to confess my inability to differentiate between the two forms.

Localities.

| Mark. | Station. | Position. | Depth. | No. | |
|---------------------|-----------|---|-------------|-----|---------------------|
| 774-7 ZEV— | 246 | Lat. N. 11° 14' 30". Long. E. 74° 57' 15". | 68—148 fms. | 4 | <i>rubrum</i> . |
| 7 3268 — | not given | Lat. N. 6° 1'. Long. E. 81° 16'. | 34 fms. | 9 | „ |
| 9 5327-8 ZEV— | 387 | Lat. N. 15° 25'. Long. E. 93° 45'. | 40—49 fms. | 2 | <i>v. stokesi</i> . |
| 7 1636 ZEV— | 201 | Lat. N. 26° 22'. Long. E. 56° 10'. | 49—48 fms. | 2 | „ |
| 7 8793 — | not given | Andamans. | not given | | |
| 6 5344 ZEV— | not given | 2ml., N. Gt. W. Tares. | 40 fms. | 1 | „ |
| 7 5895 ZEV— | not given | Snod I., Andamans. | not given | 1 | „ |
| 7 | | | | | |

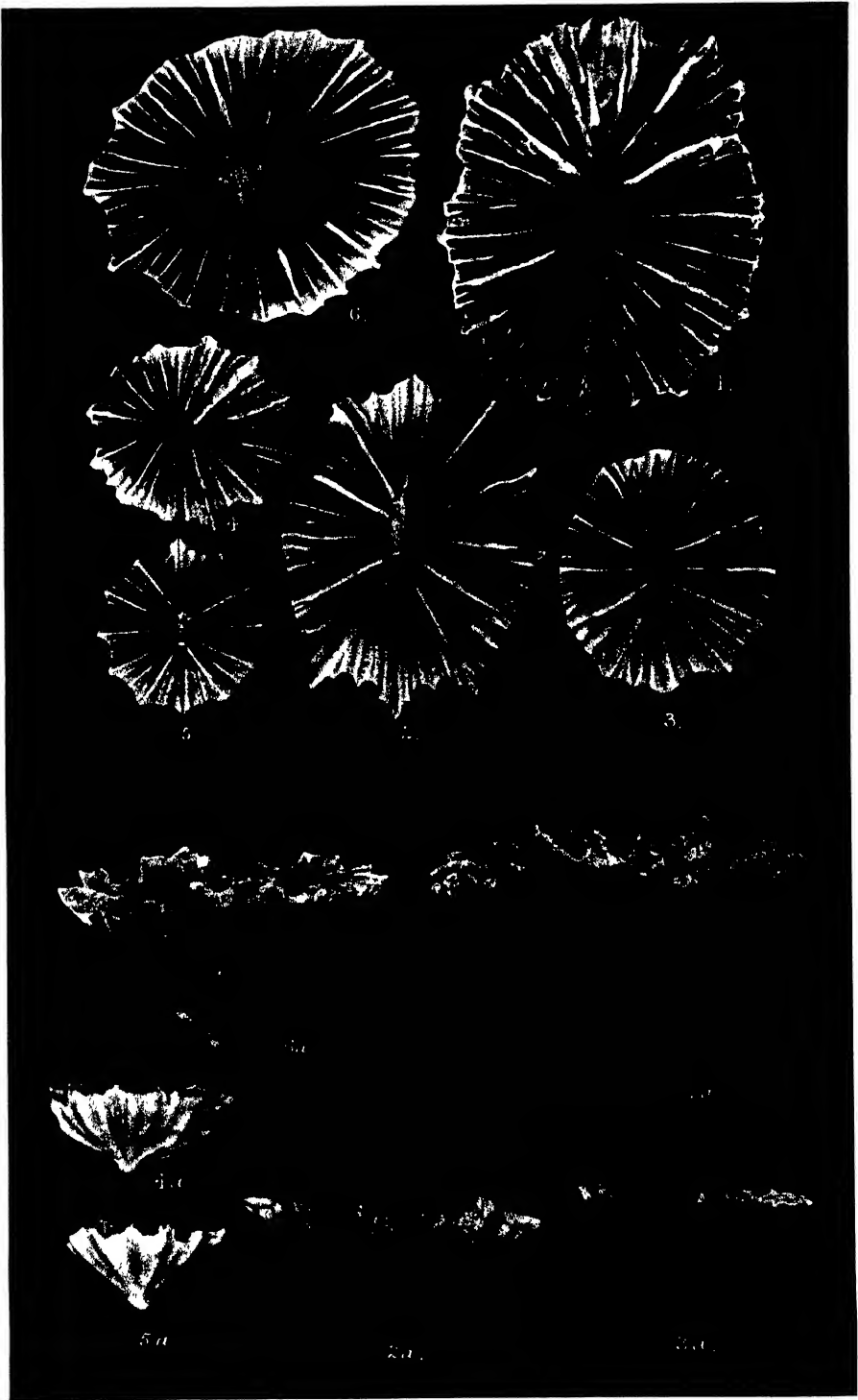
¹ I am indebted to the late Professor Jeffrey Bell, who in 1901 kindly worked out for me the authorship of the names and labels of these specimens in the British Museum.

The species is evidently of wide distribution throughout the Indian and W. Pacific Oceans. No certain specimen has as yet been recorded from the Atlantic. Its depth range is 0—100 fms. I obtained specimens from the Maldives, but none from the island groups between this archipelago and Madagascar; I can find no record from any locality distant from continental areas.

EXPLANATION OF PLATE XIII.

Flabellum japonicum Moseley. Nat. size.

- FIG. 1.—Surface view, from Sta. 242, 56-58 fms.
FIG. 1*a*.—Side view of same specimen.
FIG. 2.—Surface view, from Sta. 231, 660 fms.
FIG. 2*a*.—Side view of same specimen.
FIG. 3.—Surface view, from Sta. 275, 771-731 fms.
FIG. 3*a*.—Side view of same specimen.
FIG. 4.—Surface view, from Sta. 275, 771-731 fms.
FIG. 4*a*.—Side view of same specimen.
FIG. 5.—Surface view, from Sta. 275, 771-731 fms.
FIG. 5*a*.—Side view of same specimen.
FIG. 6.—Surface view, from Sta. 256, 937 fms.
FIG. 6*a*.—Side view of same specimen.



Flabellum japonicum Moseley.

NOTES ON FISHES IN THE INDIAN MUSEUM.

XVII.—LOACHES OF THE GENUS *NEMACHILUS* FROM BURMA.¹

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(Plates XIV, XV.)

The fishes of the genus *Nemachilus* are widely distributed in the hill streams of India and Burma and only a few of them are adapted to life in slow-running or stationary waters at high altitudes. Usually they are of a small size and are characterized by the possession of an almost cylindrical or a somewhat depressed body. They live among pebbles and shingles at the bottom of a stream and are very active in their habits. At the slightest provocation they dart from one place to another and always rest with their heads pointing upstream,² and are thus able to offer a minimum resistance to the force of the rushing current. The colouration of these loaches is very characteristic so far as the Indian species are concerned. With the exception of a few species they are marked with a variable number of vertical bars. These stripes have a great biological significance as they make the fishes living among pebbles in shallow, clear, rapid-running water inconspicuous. It has very often happened that the net revealed the presence of these fishes where I could not see them in the clear water even when a few inches deep.

Nemachili are Cobitidae without a pre- or sub-orbital spine and with a relatively short dorsal fin in which the number of branched rays does not exceed 20. Among the Indian freshwater fishes there are few genera whose taxonomy is involved in such great confusion as that of *Nemachilus*. This is in part due to the fact that many of the species exhibit considerable individual variability. Moreover, most of the

¹ For a number of years I have been collecting material for a revision of the fishes of the genus *Nemachilus* found in India. My colleagues in the Zoological Survey of India and I have made extensive collections of these loaches and a considerable amount of material has been got together from almost all parts of India. During my recent visit to Europe I compared this material with the types and the old specimens in the collection of the British Museum. Specimens of the Indian species were also examined in the Muséum National d'Histoire Naturelle, Paris; in the Zoologisches Museum der Universität, Berlin and in the Museo Civico di Storia Naturale, Genova. The collection at my disposal is so large and the taxonomy of these loaches is so confusing that I have thought it best to treat them in small batches according to their distribution. The present paper is the first of the series that I propose to publish in this journal from time to time.

² Fishes of the genus *Nemachilus*, on account of their active habits, are very difficult to catch. The best way to collect them in large numbers was to divert the course of a small channel by a dam. In the portion of the bed thus made dry these fishes can be obtained by turning over stones. Where this was not possible a bag-net was dragged at a great speed among the pebbles in the shallow portion of a stream. In this way all those forms that rest underneath stones could be netted. The presence of pebbles in the net provides the fish with hiding places and at the same time obstructs them from getting away. I have often collected large numbers of specimens in this way.

specific standards, such as number of fin-rays, scale counts, body proportions, colouration, etc., which are used in distinguishing species of most of the other Cyprinoid genera, are of very little significance in the case of *Nemachilus*. Fortunately most of the Burmese species are very peculiar and, therefore, little difficulty has been experienced in characterizing them. In distinguishing closely allied species I have relied on the character of the lateral line, the position of the anal opening with regard to the ventrals and the position of the commencement of the dorsal with regard to its distance from the tip of the snout and the base of the caudal. It is a well known fact in biology that similar environmental conditions tend to produce similar characters, and it is probable that the great resemblance between the various species of *Nemachilus* is due to a similarity in their environment, for wherever any species has taken to a life in slow running waters, it has become peculiarly modified. The usual environment—rapid-running water—of these loaches is full of storm and stress and the animals that inhabit it have to adjust themselves constantly to any fluctuations in the external conditions of their existence. In these circumstances the organisms are being modelled and remodelled till ultimately the elucidation of their true systematic position becomes a matter of considerable difficulty. This is not only true of the fishes of the genus *Nemachilus* but is also the case with all other hill-stream genera of fishes that I have studied so far.

Attempts have been made to subdivide the vast assemblage of species grouped under the generic name *Nemachilus*, but, so far as I am aware, none has proved satisfactory. In 1903, Jordan and Fowler¹ established the genus *Elixis* to accommodate those species of *Nemachilus* which possess a nasal barbel. This genus has been accepted by Weber and Beaufort² but, in 1920, Annandale and I³ doubted the generic value of this character though at that time we did not assign any reasons for our views. A perusal of the descriptions of the Burmese species is enough to show that the nasal barbel is very variable and that no specific value can be attached to it, except in such species as *N. evezardi*, where it is extremely well developed. In the material that I have examined there are a number of species showing all possible gradations between the total absence and the presence of a distinct nasal barbel. Among the Burmese species *N. cincticauda* possesses a short but well-marked nasal barbel; in *N. acuticephalus* the membrane between the nostrils is well developed and is produced into a short process in the middle; in *N. raoe* the anterior nostril is somewhat tubular and the tube is produced into a flap-like projection and in *N. brevis* the anterior nostril is produced into a long, tube-like structure.

Attention may here be directed to a species—*N. guttatus*—described by McClelland⁴ from Jorhat in Assam and characterized by the possession of only four barbels. I have not examined any specimen of this

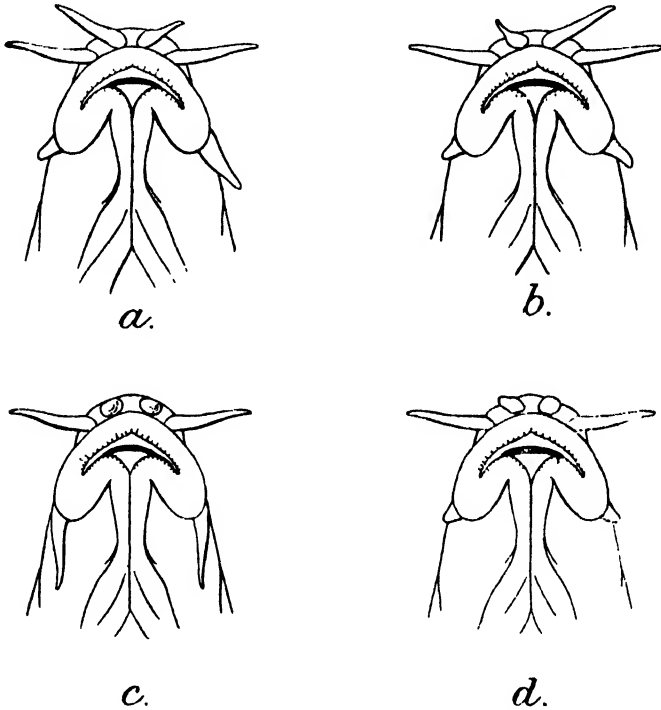
¹ Jordan & Fowler, *Proc. U. S. Nat. Mus.* XXVI, p. 768 (1903).

² Weber & Beaufort, *Fish. Indo-Austral. Archipel.* III, p. 35 (1916).

³ Annandale & Hora, *Rec. Ind. Mus.* XVIII, p. 185 (foot-note), (1920).

⁴ McClelland, *Ind. Cyprinidae in As. Res.* XIX, pp. 305, 438, pl. lii, figs. 5 & 6 (1839).

species, but it seems likely that McClelland was dealing with an abnormal specimen in which one of the pairs of barbels was greatly reduced



TEXT-FIG. 1 —Ventral surface of head of 4 specimens (a-d) of *Nemachilus kessleri* Günther showing defective barbels.

or totally lost. In a large series of examples of *N. kessleri* I have found a number of specimens in which the barbels are defective and one specimen, in which both the anterior rostrals are rudimentary (text-fig. 1, c.), appears to possess only 4 barbels. I have briefly referred to this example here to show that little importance should be attached to the number of barbels in separating the different species of *Nemachilus*.

Nichols,¹ as a result of his examination of the Chinese collection in the American Museum of Natural History, has recently proposed four groups in the genus *Nemachilus*. In the absence of any Chinese material for examination in Calcutta I do not feel myself justified in offering any remarks on Nichols' classification. It may, however, be remarked that the characters he has employed in distinguishing his groups show considerable variation in the material before me and consequently I have not been able to adopt his classification. When the systematic treatment of Indian species is completed it may be possible to review the generic classification of *Nemachilus* and related loaches.

¹ Nichols, *American Mus. Novitates*, No. 171, pp. 1-7 (1925).

Many lacunae remain to be filled up in our knowledge of the fresh-water fish-fauna of Burma. From the results of the areas investigated by the Zoological Survey of India, viz., the Inlé Lake ¹ and the Indawgyi Lake, ² it is evident that there is a considerable endemic element in the fauna, especially among the smaller forms. This conclusion applies with greater force to the inhabitants of the torrential streams. Of the 13 species of *Nemachilus* discussed here, 6 are described as new and of the remaining, 4 are endemic in Burma. Of the 3 species known from outside the political limits of Burma, 2—*N. zonalternans* and *N. sikmaiensis*—have only been recorded from the Manipur valley, the waters from which ultimately flow into the Chindwin, a tributary of the Irrawaddy River. The only remaining species—*N. botia*—is widely distributed in Indian waters, but its precise specific limits have not been properly defined and in referring certain specimens from Burma to *N. botia* I have included this species in its broadly accepted sense.

Besides the species enumerated in this paper there are some doubtful forms described or recorded from Burma. In 1869, Day ³ described *N. blythii* from two specimens in the collection of the Indian Museum and remarked in his later works ⁴ that its locality was doubtful. These specimens are still preserved in the collection of the Zoological Survey of India but are badly damaged and are not fit for any detailed work. They are, however, entered in the register as having been obtained in Burma. Without any fresh material I am not able to characterize *N. blythii* properly and consequently to include it in the synoptic table of the Burmese species.

In 1890, Vinciguerra ⁵ recorded 4 species of *Nemachilus* from Burma, namely *N. rubidipinnis*, *N. rupicola*, *N. multifasciatus* and *N. savona*. I have examined the specimens on which Vinciguerra's determinations were based. There is no doubt about the first species but the other three appear to me to have been wrongly identified. Vinciguerra's *N. savona* is the same as Blyth's *N. cincticauda* and his *N. multifasciatus* appears to represent a new species. I have not yet determined exactly the specific characters of Day's *N. multifasciatus* ⁶ and have, therefore, left out of consideration Vinciguerra's specimens referred to this species. The examples referred to *N. rupicola* by Vinciguerra are very much like those of my new species *N. virulicola* but differ in certain points. In the absence of well-preserved fresh material I am unable to assign any exact specific position to them.

The following is an artificial key to the Burmese species of the genus *Nemachilus*. *N. peguensis* is so remarkable in the character of its funnel-shaped mouth that it could be made the type of a distinct genus, but as it is represented by a single, partly damaged specimen I have refrained from adopting this course. In its general facies and build *N. shanensis* is also very striking. *N. brevis*, *N. brunneanus*, and *N. raoe* live in stationary waters and are consequently peculiarly modified.

¹ Annandale, *Rec. Ind. Mus.*, XIV, pp. 32-64, pls. i-vii (1918).

² Prashad & Mukerji, *Rec. Ind. Mus.* XXXI, pp. 161-223, pls. vii-x (1929).

³ Day, *Proc. Zool. Soc. London*, p. 552 (1869).

⁴ Day, *Fish. India*, p. 621 (1878); *Faun. Brit. Ind. Fish.*, I, p. 236 (1889).

⁵ Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, (2) IX, pp. 208-211 (1890).

⁶ Day, *Fish. India*, p. 617, pl. cliii, fig. 7 (1878).

The form of *N. acuticephalus* suggests as if the fish has adapted itself to a burrowing habit. In many respects the *Nemachili* of Burma are a very striking and diversely modified lot.

Key to the Burmese species of *Nemachilus*.

- I. A black ocellus near superior margin of base of caudal *present*. (Body finely scaled).
 - A. More than 12 branched rays in dorsal (lateral line complete) *N. rubidipinnis* (Blyth).
 - B. Less than 12 branched rays in dorsal.
 1. Distance between anal opening and ventral more than diameter of eye (lateral line almost complete) *N. botia* (Ham. Buch.).
 2. Anal opening close to ventral (lateral line ending below dorsal) *N. zonalternans* (Blyth).
- II The black ocellus near superior margin of base of caudal *absent*.
 - A. Anterior nostril in a long, flap-like tube; eye large and visible from ventral surface *N. brevis* Boulenger.
 - B. Anterior nostril normal or slightly tubular; eye not visible from ventral surface.
 1. Lateral line complete or at least extending beyond ventral.
 - a. Lips produced into a funnel-like structure (lateral line complete) *N. peguensis*, sp. nov.
 - b. Lips normal, not produced into a funnel-like structure.
 - i. Length of base of dorsal almost equals length of head (lateral line complete) *N. shanensis*, sp. nov.
 - ii. Length of base of dorsal considerably shorter than head (lateral line extending to middle of anal fin).
 - α. Depth of body 6 or more than 6 times in length without caudal *N. sikmaiensis* Hora.
 - β. Depth of body 5 or little over 5 times in length without caudal *N. rivulicola*, sp. nov.
 2. Lateral line incomplete, not extending beyond ventral.
 - a. Commencement of dorsal nearer base of caudal than tip of snout. Pectoral shorter than head.
 - i. Ventral extending considerably beyond anal opening (lateral line terminating above pectoral) *N. cinclicauda* (Blyth).
 - ii. Ventral just reaching or not extending as far back as anal opening.
 - α. Width of head almost equals height of head at occiput (a prominent black blotch in middle of base of caudal) *N. acuticephalus*, sp. nov.
 - β. Width of head considerably greater than height of head at occiput (a vertical black bar at base of caudal) *N. paucifasciatus*, sp. nvo.

- b. Commencement of dorsal nearer tip of snout than base of caudal or equidistant between the two. Pectoral longer than head.
- α. Body covered with rudimentary scales, snout more than 1.5 times diameter of eye *N. raeo*, sp. nov.
- β. Body covered with well-marked, imbricate scales, snout equal to or only slightly longer than diameter of eye *N. brunneanus* Annandale.

***Nemachilus rubidipinnis* (Blyth).**

1860. *Cobitis rubidipinnis*, Blyth, *Journ. As. Soc. Bengal*, XXI, p. 169.
 1860. *Cobitis semizonata*, Blyth, *ibid.*, p. 170.
 1868. *Nemachilus rubidipinnis*, Günther, *Cat. Brit. Mus. Fish.*, VII, p. 348.
 1868. *Nemachilus semizonata*, Günther, *ibid.*, p. 348.
 1878. *Nemacheilus rubidipinnis*, Day, *Fish. India*, p. 614, pl. clii, fig. 4.
 1889. *Nemachilus rubidipinnis*, Day, *Faun. Brit. Ind. Fish.*, I, p. 226.
 1890. *Nemachilus rubidipinnis*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, (2) IX, p. 208.

Blyth described two species of *Nemachilus* from Tenasserim with a long dorsal fin, viz. *N. rubidipinnis* and *N. semizonata*. Both these species were included by Günther in his *Catalogue* without any comment and were characterized after Blyth. It appears likely that Günther was greatly influenced in recognising these two as separate species by the number of rays in the dorsal fin which is stated by Blyth to be 16 in *N. semizonata* and 15 in *N. rubidipinnis*. Day obtained a specimen from Dr. Anderson of the Indian Museum, Calcutta, and described and figured it as *N. rubidipinnis* of Blyth. This very specimen appears to have been later on purchased from Day by the Indian Museum and is now preserved in our collection. It is entered in the register, No. 2680, as the type of *N. rubidipinnis* from Tenasserim. Day's figure of the specimen is of natural size and from its measurements and colouration it seems to me to be the type of *N. semizonata* and not of *N. rubidipinnis* even if the two species he considered synonymous now. The type of *N. rubidipinnis* was $3\frac{3}{4}$ inches in length, while the specimen under consideration is much smaller.

According to Blyth the main difference between the two species lies in that the body is "proportionately less deep" in *N. semizonata* than in *N. rubidipinnis*. Another peculiar character of *N. rubidipinnis* according to Blyth "consists in a short broad obtuse spine-like process projecting from the middle of the upper lip". This spine-like process of the premaxillaries is found in several species of *Nemachilus* and is usually well developed in those that possess a long dorsal fin such as *N. paronaceus* and *N. botia*. This structure is also found in the type-specimen of *N. semizonata* referred to above. In the description of *N. semizonata*, Blyth refers to "a minute spinelet above the muzzle (as in *C. monocera*, McClelland)". I have carefully examined the type-specimen for this structure and find that it consists of a sharp, dorsally directed process of the premaxillaries, corresponding in position to the spine-like process projecting from the upper jaw, and it seems likely

that the two structures are produced in correlation to each other since this spinelet on the muzzle is present in a more or less well-developed form in all the species of *Nemachilus* with a long dorsal fin.

As regards differences in the colouration of the two species it seems probable that on account of age or as an abnormality the ground-colour of *N. rubidipinnis* was "olive-brown with a ruddy wash" in the type-specimen, whereas in the smaller specimen described as *N. semizonata* the body had "a series of twelve to fourteen dark transverse dorsal bands"; etc. I have noticed such differences in colouration among specimens of other species. The colour markings on the dorsal and the caudal fins is the same in the two species except that there is a slight variation in the number of rows. The black ocellus at the base of the caudal fin described by Blyth for his *N. semizonata* is a common character of a number of species of *Nemachilus* and especially of those that possess a long dorsal fin.

From the above it is clear that Blyth's two species from Tenasserim, viz. *N. rubidipinnis* and *N. semizonata*, are synonymous and that the differences noted between them are not of any specific value. The number of rays in the dorsal fin is, as is shown below, a variable character.

Vinciguerra, in 1890, recorded *N. rubidipinnis* from Mandalay (Upper Burma), Kokarit and Meetan (Lower Burma) and thus considerably extended the range of the species. Through the kindness of Dr. D. Vinciguerra I have with me three specimens from Fea's collection and with all this material in hand it seems worth while to redescribe this species here.

D. 3/13-17; P. 1/11-13; V. 1/7; A. 3/5.

Nemachilus rubidipinnis is a long and slender species. The length of the head is contained 4.4 to 4.8 times and the depth of the body 5.1 to 6.1 times in the total length without the caudal. The eye is situated almost in the middle of the length of the head or somewhat in the posterior half of the head; its diameter is contained 4 to 5 times in the length of the head, 1.5 to 2.1 times in the length of the snout and is greater than the interorbital width. The nostrils are close together and are situated nearer the eye than the tip of the snout; the anterior nostril is tubular to a certain extent and the internarial membrane is prominent. The mouth is situated on the ventral surface behind the tip of the snout and is bordered by thick lips, the lower lip is interrupted in the middle and is raised into two button-like projections. The barbels are long and thread-like; the inner rostral almost reaches the eye, while the outer rostral and the maxillary both extend beyond the eye. The upper jaw is produced into a beak-like process in the middle which, when the animal bites, comes in front of the lower jaw. There is a minute spinelet above the muzzle.

The body is entirely covered with distinct, imbricate scales and the lateral line is complete.

The dorsal fin originates considerably in advance of the ventral and its commencement is much nearer the snout than the base of the caudal. The base of the dorsal fin is much longer than the head. The pectoral

fin is long and pointed; it is almost as long as or slightly shorter than the head; it is separated from the ventral by a distance equal to a third of its length. The ventral fin is also long and pointed but is much shorter than the pectoral. It is separated from the anal opening by a considerable distance. The anal fin is small and does not extend to the base of the caudal. The caudal fin is almost as long as or slightly longer than the head; its posterior margin is more or less entire. The caudal peduncle is fairly stout; it is as long as or slightly longer than its depth.

The colouration according to Day is "reddish brown, with 12 to 16 irregular darkish bands descending from the back and ending in dark spots below the lateral line: 4 to 6 oblique bands on the dorsal fin: 6 to 8 irregularly vertical bars on the caudal, which has a black ocellus on the upper half of its base".

Locality.—Burma (Tenasserim, Meetan, Kokrait and Mandalay).

Measurements in millimetres.

| | Tenasserim. ¹ | Mandalay. | | Meetan. |
|---|--------------------------|-----------|------|---------|
| Total length without caudal | 64.0 | 73.0 | 56.5 | 57.2 |
| Length of head | 14.3 | 15.0 | 12.3 | 12.4 |
| Depth of body | 12.5 | 13.4 | 10.0 | 9.3 |
| Diameter of eye | 3.2 | 3.0 | 3.0 | 3.2 |
| Length of snout | 5.6 | 6.3 | 5.0 | 4.7 |
| Interorbital distance | 3.0 | 2.6 | 2.3 | 2.3 |
| Length of caudal peduncle | 10.0 | 11.2 | 7.5 | 7.7 |
| Least height of caudal peduncle | 8.0 | 9.0 | 7.3 | 7.3 |
| Length of pectoral | 13.0 | 15.0 | 11.3 | 11.2 |
| Length of ventral | 10.1 | 12.3 | 10.5 | 9.5 |

Nemachilus botia (Ham. Buch.).

A very wide range of distribution has been assigned to *N. botia* and so far as I am aware the precise specific limits of this species have not been ascertained. In the "Gangetic Fishes" Buchanan mentions that the "Botia is found in the rivers of the north-eastern parts of Bengal" ² and his original notes concerning the "Gangetic Fishes" show that the types of his description were obtained from the Brahmaputra River at Goalpara. However, at the present moment I am not in a position to elucidate the precise diagnostic characters of the species and, therefore, recognize it here in its usually accepted sense.

Nemachilus botia has twice been recorded from Burma. Boulenger ³ recorded it from NampanDET in the Southern Shan States and according to Annandale ⁴ this species is common in small streams in the hills round about the Inlé Lake. Chaudhuri ⁵ recorded *N. botia* from Tanja on the North-Eastern frontier of Burma. In the collection there is a fine specimen from Shatu Jup, Myitkyina and Hukong Valley frontier,

¹ Type-specimen of *Nemachilus semizonata* (Blyth) figured by Day in *Fishes of India*.

² Hamilton-Buchanan, *An Account of the Fishes found in the River Ganges and its branches*, p. 350 (Edinburgh: 1822).

³ Boulenger, *Ann. Mag. Nat. Hist.* (6) XII, p. 203 (1893).

⁴ Annandale, *Rec. Ind. Mus.* XIV, p. 35 (1918).

⁵ Chaudhuri, *Rec. Ind. Mus.* XVI, p. 279 (1919).

collected by Dr. Murray Stuart. A number of young examples, probably referable to this species, were obtained by Dr. B. N. Chopra from the north end of the Indawgyi Lake and in small rocky streams round about Kamaing, Myitkyina District.

***Nemachilus zonalternans* (Blyth).**

1860. *Cobitis zonalternans*, Blyth, *Journ. As. Soc. Bengal*, XXIX, p. 172.
 1869. *Nemacheilus zonalternans*, Day, *Proc. Zool. Soc. London*, p. 551.
 1878. *Nemacheilus zonalternans*, Day, *Fish. India*, p. 618.
 1889. *Nemachilus zonalternans*, Day, *Faun. Brit. Ind. Fish.*, I, p. 232.
 1921. *Nemachilus zonalternans*, Hora, *Rec. Ind. Mus.* XXII, p. 199. pl. x, figs. 3, 3a.

This small loach was characterized by Blyth from two specimens obtained by Major Berdmore in the Tenasserim Provinces, but his diagnosis was considered insufficient by Günther and the species was, therefore, not included in his *Catalogue*. Later on Day examined the type-specimens and gave some further particulars about the diagnostic features of the species. In 1920, I collected a large number of specimens of this species in the Manipur Valley, Assam, and in the following year described it in detail from this fresh material. A few observations were also made on the type-specimens, which, unfortunately, are now missing from the collection.

From its general facies *N. zonalternans* appears to be an inhabitant of sluggish waters and in the Manipur Valley the specimens were obtained from muddy streams or from relatively deeper streams at the base of the hills. The species can be readily distinguished by its small size and characteristic *N. botia*-like colouration. The distribution of this species, as known at present, is discontinuous but this is mainly due to the fact that the fauna of the intermediate region has not been properly investigated so far.

***Nemachilus brevis* Boulenger.**

(Plate XV, fig. 10.)

1893. *Nemachilus brevis*, Boulenger, *Ann. Mag. Nat. Hist.* (6) XII, p. 203.
 1918. *Nemachilus brevis*, Annandale, *Rec. Ind. Mus.* XIV, p. 43, pl. ii, figs. 1, 1a.

Nemachilus brevis was described from 3 specimens collected from the Inlé Lake at Fort Stedman. Later, Annandale obtained a large number of specimens of this species from several localities in the Inlé basin and on the He-Ho plain. In 1922, I collected some further material from the Inlé Lake and from a stream flowing out of the "White-Crow Tank" at the base of the Tongyi Hill. The species has so far been found only in still and slow-running waters and is very well adapted for this type of habitat. Its large and bulging eyes, long barbels, deep body with rounded ventral surface and its tubular anterior nostrils are all characteristic modifications in response to its peculiar habitat.

It was pointed out by Annandale that "the male differs from the female in colouration and also in the shape of the body; as a rule, instead of being merely spotted or mottled, it has on the sides a number of short black vertical bars, which sometimes fuse together to form an

irregular longitudinal bar. The bars are variable both in number and in size. The male has, further, a small cartilagenous pad immediately in front of the lowest quarter of the eye". Besides these points I find that the males are, as a rule, smaller in size and possess relatively longer fins. The black, longitudinal band along the lateral line is a striking feature of the male.

In *N. brevis* the mouth is bordered by thick lips which are continuous at the angles. The lower lip is interrupted in the middle line and its two halves are thrown into a number of folds. The upper lip is also somewhat pleated.

Measurements in millimetres.

| | ♀ | ♀ | ♂ | ♂ |
|---|------|------|------|------|
| Total length including caudal | 57.5 | 56.2 | 47.0 | 41.3 |
| Length of caudal | 9.0 | 9.2 | 8.0 | 7.7 |
| Length of head | 12.8 | 12.5 | 10.3 | 9.4 |
| Depth of body | 12.4 | 12.0 | 9.5 | 7.8 |
| Length of snout | 4.6 | 4.2 | 3.0 | 3.0 |
| Diameter of eye | 3.0 | 3.5 | 3.0 | 2.6 |
| Interorbital distance | 3.7 | 3.3 | 2.7 | 2.3 |
| Length of caudal peduncle | 6.5 | 6.0 | 5.5 | 5.3 |
| Least height of caudal peduncle | 5.3 | 5.0 | 4.2 | 3.4 |
| Longest ray of dorsal | 8.4 | 8.3 | 7.0 | 7.0 |
| Length of pectoral | 9.0 | 8.8 | 9.3 | 8.8 |
| Length of ventral | 7.3 | 7.4 | 7.0 | 6.3 |
| Longest ray of anal | 7.2 | 7.4 | 6.7 | 6.0 |

***Nemachilus peguensis*, sp. nov.**

(Plate XIV, figs. 1, 2.)

D. 3/9; P. 1/11; V. 1/8; A. 9?

Nemachilus peguensis is a small and slender species in which both the dorsal and the ventral profiles are somewhat arched. The ventral surface is flattened in front of the ventrals and the tail is compressed from side to side.

The head is pointed and its length is contained 4 times in the total length without the caudal; its greatest width is equal to its length excluding the snout; its height at the occiput is equal to half of its length. The depth of the body is contained 6 times in the total length without the caudal. The eye is situated somewhat in the posterior half of the head and the snout is longer than the postorbital part of the head; the diameter of the eye is contained 4.5 times in the length of the head, 2 times in the length of the snout and 1.1 times in the interorbital distance. The eye is not visible from the ventral surface. The nostrils are situated close to the dorso-anterior border of the orbit. The mouth is situated in a cup-shaped structure formed by the lips; it is ventral in position and is placed considerably behind the tip of the snout. The anterior lip is greatly hypertrophied and its edges are raised, forming a funnel-shaped structure; on the inner side it is lined with a sort of horny substance. The posterior lip is represented by

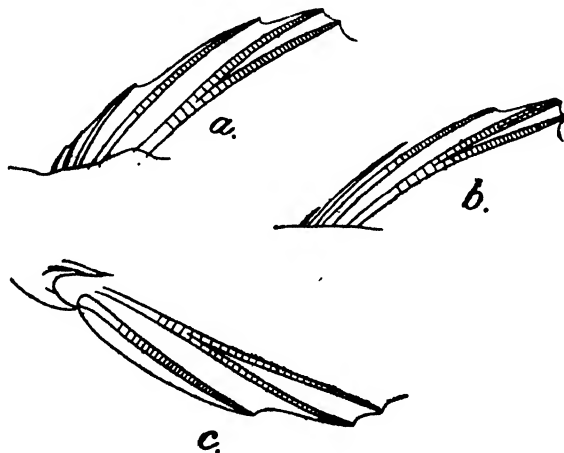
Nemachilus shanensis, sp. nov.

(Plate XV, figs. 5, 6.)

D. $4\frac{4}{9}$; P. $1\frac{1}{8}$; V. $1\frac{1}{6}$; A. $3\frac{3}{6}$.

In *Nemachilus shanensis* the head and the anterior part of the body are somewhat depressed and the under surface is flattened. The paired fins are horizontally placed and are specially modified to serve as adhesive organs. The fish is stout, muscular and well-built.

The head is short and globular ; its length decreases proportionately with the growth of the fish as does also the depth of the body. The length of the head is contained from 4.5 to 5 times and the depth of the body 5.1 to 6 times in the length without the caudal. The eye is situated almost in the middle of the length of the head and its upper margin is slightly raised above the dorsal profile of the head ; its diameter is contained 4 to 4.2 times in the length of the head, 1.7 to 1.9 times in the length of the snout and is almost equal to the interorbital distance. The eye is not visible from the ventral surface. The nostrils are situated close together and are much nearer to the eye than to the tip of the snout. The barbels are short and stumpy ; the inner rostrals are shorter than the diameter of the eye, while the other two pairs are somewhat longer. The mouth is ventral, placed slightly behind the tip of the snout ; the lips are thick and continuous at the angle but the lower lip is interrupted in the middle line by a narrow channel. The lips leave the lower jaw and the middle portion of the upper jaw free and exposed ; the exposed portions of the jaws are covered with a thick horny layer.



TEXT-FIG. 2.—Nature and arrangement of the spines in the fins of *Nemachilus shanensis*, sp. nov. a = Spines of dorsal ; b = spines of anal ; c = spine of pectoral.

There are minute, indistinct scales covering the entire body. The lateral line is complete.

The dorsal fin is fairly extensive and is fan-shaped in outline ; it originates in advance of the ventral and its commencement is equidistant between the tip of the snout and the base of the caudal fin. The height of the dorsal fin is less than the length of the head, but the length of its base almost equals the length of the head. The 4 spines of the dorsal fin are enclosed in a thick membrane and appear as a single spine. The last dorsal spine is segmented distally for a greater part of its length. The membranes in between the rays are provided with skin pads. The anal fin is as high as the dorsal and its three spines are enclosed in a thick membrane, so that superficially they appear as one, the last spine is segmented distally for the greater part of its length. The anal fin is considerably removed from the anal opening and its commencement is nearer to the base of the caudal than to the origin of the ventral fin. The membranes in between the rays are thickened in their proximal halves. The pectoral fin is considerably longer than the head and extends for about two-thirds of the distance to the base of the ventral. The pectoral is pointed in the middle and the rays according to their lengths are so arranged along the outer border that the outline becomes indented. The outermost ray is simple and bears a broad and thick pad of skin anteriorly ; it is segmented for a greater portion of its length distally. The ventral fin is shorter than the pectoral and just misses the vent ; its outermost ray is modified in the same way as that of the pectoral. There is a fleshy appendage at the base of the ventral. Both the paired fins are horizontally placed, and the membranes between the rays are provided with pads of skin which are used for purposes of adhesion. The caudal fin is longer than the head and is deeply forked ; both the lobes are rounded at their extremities. The upper lobe of the caudal fin is longer and better developed than the lower. The caudal peduncle is $1\frac{1}{4}$ times as long as high.

The colouration, in spirit specimens, is characteristic of the species. There are about 8 to 9 short, broad bars along the lateral line and a few similar markings on the dorsal surface in the tail region. Anteriorly the upper surface of the body is irrorated with black spots. The upper surface and the sides of the head are gray and there is a black streak along the lateral line. The ventral surface is pale. The rays of the dorsal fin are provided with two rows of black spots ; there is also a black blotch at the base of the spines and the anteriormost ray. The caudal fin is provided with a number of vertical, black bands composed of longitudinal short bars.

Type-specimen.—F $\frac{11058}{1}$, Zoological Survey of India, Calcutta (*Ind. Mus.*).

Locality.—Thale-ú Stream near Fort Stedman, Southern Shan States, Burma.

Remarks.—There are 5 specimens of this species in the collection. They were collected by me from a rapid-running, rocky stream in March 1922. *N. shanensis* is highly modified for life in swift currents and has a very characteristic facies. It can be readily distinguished by the form of its fins and by its characteristic colouration.

Measurements in millimetres.

| | | | |
|---|------|------|------|
| Total length including caudal | 63.0 | 60.0 | 48.0 |
| Length of caudal | 11.5 | 11.5 | 9.8 |
| Length of head | 10.2 | 9.8 | 8.5 |
| Depth of body | 8.6 | 9.5 | 6.8 |
| Length of snout | 4.5 | 4.5 | 3.6 |
| Diameter of eye | 2.5 | 2.3 | 2.1 |
| Interorbital distance | 2.5 | 2.2 | 2.2 |
| Length of caudal peduncle | 7.0 | 6.6 | 5.5 |
| Least height of caudal peduncle | 5.5 | 5.5 | 4.2 |

Nemachilus sikmaiensis Hora.

1921. *Nemachilus sikmaiensis*, Hora, *Rec. Ind. Mus.* XXII, p. 201, pl. ix, fig. 4; pl. x, figs. 1, 1a.

Nemachilus sikmaiensis is a small loach of slender build. It inhabits shallow, rocky streams with clear and rapid-running water. The species was described from 9 specimens collected by me in the Manipur Valley (Sikmai Stream near Palel on the Burma Road) and recently Dr. B. N. Chopra obtained a large number of specimens from the Myitkyina District, Upper Burma (streams in the neighbourhood of Kamaing). The Burmese examples differ from the Assamese in having fewer bars on the body and in the markings being of a much deeper colour. The specimens collected by Dr. Chopra do not exceed 3.5 cm. in length and in none of them I have been able to distinguish the secondary sexual characters of the male.

Measurements in millimetres of Burmese examples.

| | | | |
|---|------|------|------|
| Total length including caudal | 33.6 | 32.3 | 30.0 |
| Length of caudal | 7.0 | 6.5 | 5.8 |
| Length of head | 6.4 | 6.5 | 5.8 |
| Depth of body | 4.3 | 4.1 | 3.6 |
| Length of snout | 2.4 | 2.6 | 2.0 |
| Diameter of eye | 1.4 | 1.3 | 1.3 |
| Interorbital distance | 1.5 | 1.5 | 1.3 |
| Length of caudal peduncle | 2.7 | 2.7 | 2.2 |
| Length of pectoral | 5.6 | 6.0 | 5.5 |
| Length of ventral | 5.3 | 5.0 | 4.6 |

Nemachilus rivulicola, sp. nov.

(Plate XV, figs. 3, 4.)

D. 4/8; P. 1/10; V. 1/6; A. 3/5-6.

Nemachilus rivulicola is a small and slender species which replaces *N. brunneanus* Annandale in the clear, rapid-running streams of the Inlé Basin. Annandale's *N. brunneanus*, as remarked elsewhere, is a typical sluggish water form and can be readily distinguished from the new species by its large eyes and long paired fins.

In *N. rivulicola* the head and the anterior part of the body are slightly depressed and the ventral surface in this region is flattened. The tail is compressed from side to side. The head is almost as broad as high at the occiput, its length is contained 4.1 to 4.3 times in the total length without the caudal. The eye is situated somewhat in the anterior half of the head, and is not visible from the ventral surface; its diameter is contained 3.6 to 4 times in the length of the head and 1.4 to 1.7 times

in the length of the snout. The eyes are relatively larger in the young individuals. The nostrils are situated close together, nearer to the eye than to the tip of the snout. The mouth is situated on the ventral surface slightly behind the tip of the snout and is bordered by thick lips which are continuous at the angles. The lower lip is somewhat corrugated and slightly interrupted in the middle line. There are two pairs of rostrals and a pair of maxillary barbels; the inner rostral does not reach the eye, the outer rostral reaches to the middle of the eye, while the maxillary barbel, which is almost as long as the outer rostral, extends beyond the eye.

The body is covered with small indistinct scales. The lateral line is well-marked up to the middle of the base of the anal fin, beyond which it is not clear or is absent.

The dorsal fin originates in advance of the ventrals and its commencement is nearer the tip of the snout than the base of the caudal. The height of the dorsal fin is less than the length of the head, but is greater than the depth of the body below it. The four spines of the dorsal fin are enveloped in a thick membrane and can be made out only after a careful dissection. The pectoral fin is pointed in the middle and is almost as long as the head; it is separated from the ventral by a distance equal to half of its length. The ventrals are considerably smaller than the pectorals and extend as far back as the anal opening; they are provided with fleshy appendages at their bases. The anal fin commences at a distance of one and a half diameters of the eye from the anal opening and does not reach the base of the caudal fin; it is not as high as the dorsal fin. The caudal fin is longer than the head and is forked in the last third of its length; both the lobes are of equal size and are bluntly pointed. The least height of the caudal peduncle is contained 1.2 to 1.4 times in its length.

The colouration of the specimens before me does not vary much. The ground colour of the head and body is pale olivaceous. The dorsal surface of the head is mottled and spotted with black. There is a variable number of dark horizontal bars on the sides of the body, fairly broad behind the dorsal and anteriorly broken up into a number of narrower bars. Even in the posterior region there are indications of these bars breaking up. The dorsal fin is provided with a dark spot at its base in front and with two rows of dotted longitudinal lines on its rays. The caudal fin bears two or three faint V-shaped markings and a narrow, black, somewhat interrupted band at its base. The other fins are generally without any markings.

Type-specimen.—F $\frac{11060}{1}$, Zoological Survey of India, Calcutta (*Ind. Mus.*).

Locality.—Clear, rocky streams in the Yawnghwe Valley and the He-Ho plain, S. Shan States, Burma. I collected several specimens in a stream flowing out of a small spring near Fort Stedman.

Remarks.—It seems likely that *N. rivulicola* and *N. brunneanus* are derived from a common ancestral stock and the specific differences now noticeable between them are probably due to the divergence in their habitats. The distinctive features of both the species can be correlated with the types of environment they now inhabit.

Measurements in millimetres.

| | | | |
|---|------|------|------|
| Total length including caudal | 58.0 | 58.0 | 48.5 |
| Length of caudal | 12.0 | 12.0 | 10.0 |
| Length of head | 11.2 | 10.6 | 9.0 |
| Depth of body | 8.6 | 8.8 | 7.5 |
| Length of snout | 5.0 | 4.0 | 4.0 |
| Diameter of eye | 2.8 | 2.8 | 2.5 |
| Interorbital distance | 3.3 | 4.0 | 2.2 |
| Length of caudal peduncle | 6.8 | 7.0 | 6.0 |
| Least height of caudal peduncle | 5.7 | 5.0 | 4.5 |
| Length of pectoral | 10.8 | 11.3 | 9.0 |
| Length of ventral | 8.5 | 8.8 | 7.4 |

Nemachilus cincticauda (Blyth).

(Plate XIV, figs. 3, 4.)

1860. *Cobitis cincticauda*, Blyth, *Journ. As. Soc. Bengal*, XXIX, p. 172.1869. *Nemacheilus cincticauda*, Day, *Proc. Zool. Soc. London*, p. 552.1890. *Nemachilus savona*, Vinciguerra (nec Hamilton-Buchanan), *Ann. Mus. Civ. Stor. Nat. Genova*, (2) IX, p. 211.

Blyth characterised *Nemachilus cincticauda* as follows: "Very like *C. scaturiginea*, B. H., but with fewer rays to the dorsal and anal (*viz.* seven and six respectively), and the body more regularly banded; shewing about ten dorsal transverse bands which are broader than the alternating yellowish bands, and a strongly marked black transverse bar at base of tail,—also a dark bar between the eyes and mouth, crossing the muzzle. Two black spots on base of dorsal, and above them a black speck on each ray; the other fins without markings. Length 2 in. Tenasserim Provinces." Günther considered the above description insufficient and did not include this species in his *Catalogue*. Day, 1869, examined the type-specimen in the collection of the Indian Museum and redescribed the species in greater detail. He mentioned that the specimen, "2 inches long", was "received from Major Berdmore, who obtained it at Pegu". Later on Day described and figured a specimen from Prome as *N. cincticauda* in his *Fishes of India* and repeated this description in the *Fauna*. There are several important differences between the two descriptions and it seems certain that Day was not dealing with the same species in the two cases. Some of the salient points distinguishing the two forms are given below:—

N. cincticauda (P. Z. S., p. 552, 1869).*N. cincticauda* (Fish. Ind., p. 619, 1878).

1. D. 2/7.

D. 2/8.

2. Eyes "nearly 3 diameters from the end of the snout, 1½ diameters apart".

Eyes "2 diameters from end of snout, 1½ diameters apart".

3. "No projection on the preorbital."

"Preorbital projecting and with a free lower edge in some but not in all examples."

4. Dorsal "commences midway between the posterior margin of the orbit and the base of the caudal fin", which "is slightly emarginate".

Dorsal "arises nearer the snout than the base of the caudal, which last is slightly forked with pointed lobes". In the figure, however, the caudal fin is deeply forked.

Besides these points there are differences in proportions, etc., of the various parts of the body. Unfortunately there is neither the type-specimen nor any other old specimen of this species in our collection and I am, therefore, unable to comment any further on the specimen described by Day as *N. cincticauda* from Prome. There are, however, two examples (Nos. 89-2-1—1666-7) in the collection of the British Museum presented by Day and stated to have been collected at Prome. These specimens are labelled *N. subfuscus* ? and are not in a very good state of preservation, but so far as can be judged they resemble *N. blythii* Day and differ considerably from *N. cincticauda* (Blyth). In the same collection there are thirteen specimens (Nos. 80-12-1—50-63) from Tenasserim presented by J. Wood Mason. They are labelled *N. savona*, but they very probably represent *N. cincticauda* Blyth.

In the collection of the Zoological Survey of India there are 6 specimens collected by Dr. F. H. Gravely at Sukli on the east side of the Dawna Hills in November, 1911. These examples agree very closely with Blyth's description of *N. cincticauda* and with Day's description of this species from the type-specimen. There is no doubt in my mind that these examples represent Blyth's *N. cincticauda* and as this species has not so far been properly understood, I take this opportunity to redescribe it in detail.

D. 2/7 ; P. 1/8 ; V. 1/8 ; A. 2-3/5.

Nemachilus cincticauda is a small, but strongly built species. The head and the anterior part of the body are greatly depressed and the tail, which is very muscular, is compressed from side to side. The dorsal profile is slightly arched and the ventral is almost straight and horizontal. The ventral surface of the head and the body is flattened.

The head is considerably broader than its height and its length is contained 4.1 to 4.5 times in the total length without the caudal. The body is narrow and its depth is contained 6.1 to 7 times in the total length without the caudal. The eyes are small, dorso-laterally directed and are situated in the middle of the length of the head ; they are not visible from the ventral surface. The diameter of the eye is contained 4.6 to 6 times in the length of the head, 2 to 2.5 times in the length of the snout and 1.2 to 1.7 times in the interorbital distance. The nostrils are situated close together only a short distance anterior to the eye. The membrane between the nostrils is produced into a short, but well-marked barbel-like process. The mouth is situated on the ventral surface slightly behind the tip of the snout ; the mouth opening is lunate and is twice as wide as the diameter of the orbit. It is bordered by fleshy, crenulated lips which are continuous at the angles ; the lower lip is partly divided in the middle line. The three pairs of barbels are well developed and are of equal length ; the inner rostral extends to the front margin of the eye, the outer rostral to the middle of the eye and the maxillary extends considerably beyond the eye. There are rows of open pores on the head.

The body is covered with minute, non-imbricate scales and the lateral line is incomplete, ending before the termination of the pectoral fin.

The dorsal fin is small and originates slightly behind the ventral; its commencement is considerably nearer to the base of the caudal than to the tip of the snout; its height is greater than the depth of the body below it. The paired fins are more or less horizontally placed, the pectoral is shorter than the head and extends for about two-thirds of the distance to the ventral, which is shorter than the pectoral and extends considerably beyond the anal opening. The ventral is separated from the anal fin by a distance equal to twice the diameter of the orbit. The anal just misses the caudal, which is slightly emarginate and is almost as long as the head. The caudal peduncle is short and stout; it is almost as long as deep.

The colouration in spirit agrees with that given by Blyth. There are about 10 to 11 broad, black bands on the body, broader than the pale olivaceous interspaces between them. The base of the caudal fin is provided with a black vertical streak and there is a black blotch at the base of the anterior rays of the dorsal fin. There is an indication of a row of black spots in the middle of the dorsal fin. The other fins are without any markings. The upper surface of the head is dusky and the ventral surface dull-white.

Locality.—Lower Burma (Dawna Hills and Tenasserim Province).

Remarks.—At my request Dr. D. Vinciguerra sent me for examination the two specimens from "Thagata Juva" referred by him to *N. savona*. After a careful study I have determined them as *N. cincticauda*, but it is unfortunate that both these examples were badly damaged during transit when the material was sent to the British Museum, London, for my examination.

Measurements in millimetres.

| | | | | |
|---|------|------|------|------|
| Total length excluding caudal | 46.0 | 43.0 | 38.5 | 35.5 |
| Length of head | 10.1 | 9.6 | 9.2 | 8.3 |
| Depth of body | 6.3 | 6.8 | 6.0 | 5.8 |
| Diameter of eye | 2.2 | 1.6 | 1.8 | 1.6 |
| Length of snout | 4.5 | 4.0 | 4.0 | 3.5 |
| Interorbital distance | 3.5 | 2.8 | 2.2 | 2.3 |
| Length of caudal peduncle | 7.3 | 5.2 | 6.0 | 5.0 |
| Least height of caudal peduncle | 5.6 | 5.8 | 5.0 | 5.0 |
| Longest ray of dorsal | 7.8 | 7.2 | 6.5 | 6.2 |
| Longest ray of anal | 7.0 | 6.0 | 5.5 | 5.5 |
| Longest ray of pectoral | 9.8 | 8.8 | 8.3 | 7.5 |
| Length of ventral | 8.8 | 8.0 | 7.0 | 6.7 |

***Nemachilus acuticephalus*, sp. nov.**

(Plate XIV, figs. 5, 6.)

. D. 3/7; P. 1/8; V. 1/6; A. 2/5.

Nemachilus acuticephalus is a remarkable species as regards its general facies. It is a small and slender loach in which both the profiles are slightly arched and the ventral surface is rounded.

The head is almost cylindrical and pointed anteriorly. When the fish rests on the ground it seems probable that the ventral surface of

the head does not come in contact with the substratum. The length of the head is contained 4.5 to 4.9 times in the total length without the caudal, its greatest width equals its height at the occiput which is slightly less than the postorbital part of the head. The depth of the body in female specimens full of eggs is contained 5.3 to 5.9 times in the total length without the caudal. The eyes are minute and are situated in the anterior half of the head; they are not visible from the ventral surface. The mouth is small and is situated on the ventral surface slightly behind the tip of the snout, it is bordered by thin lips which are continuous at the angle. The lower lip is interrupted in the middle line. The nostrils are placed close together and their situation is much nearer to the eye than to the tip of the snout. The membrane between the nostrils is well developed; it lies over and entirely covers the posterior nostril and is distally produced into a short process in the middle. The barbels are thread-like, two pairs rostrals and one pair maxillary. The inner rostral extends to the nostril, the outer rostral to the middle of the eye and the maxillary extends beyond the eye.

The body is covered with small, rudimentary scales which are embedded in the skin and are hardly distinguishable. The lateral line is incomplete, it terminates in between the pectoral and the dorsal fins.

The dorsal fin is small; it originates slightly in advance of the ventral and its commencement is much nearer the base of the caudal than the tip of the snout; its height is less than the length of the head. The pectoral is much shorter than the head and extends about half way to the base of the ventral. The ventral is even shorter than the pectoral and is separated from the anal opening by a considerable distance; it is provided with a fleshy appendage at its base. The anal fin is very small and does not extend to the base of the caudal fin, which is as long as the head. The caudal fin is forked in the last third of its length, the two lobes are pointed and are almost of equal length. The rays in all the fins are cramped together and it is only with difficulty that their number in each fin can be counted. Along the dorsal surface between the bases of the dorsal and the caudal fin the skin is raised into a low ridge forming a semi-transparent adipose fin such as is found in fishes of the genus *Adiposia*.¹ A similar but much less extensive ridge occurs along the ventral surface also between the anal and the caudal fins. The least height of the caudal peduncle is contained 1.2 to 1.3 times in its length.

In the preserved specimens before me the colour is considerably faded, but still 11-13 vertical bars can be made out on the body. These bars are wider than the interspaces between them. The dorsal fin possesses a black spot at the base of its anterior rays and there is a distinctive black blotch on either side of the caudal peduncle at the base of the caudal fin. The general colouration of the preserved specimens is pale olivaceous.

Type-specimen.—F ⁶⁸⁷⁵/₁, Zoological Survey of India, Calcutta (*Ind. Mus.*).

¹ Annandale & Hora, *Rec. Ind. Mus.* XVIII, p. 182, fig. 10 (1920).

Locality.—Hwe-gna-sang River, in the Pazi Township, of the Mong-long Sub-division of Hsipaw State, Northern Shan States, Burma. The Hwe-gna-sang stream is one of the branches of the upper waters of the Madeya river, which runs into the Irrawaddi a short distance above Mandalay.

Remarks.—There are only five specimens of this species in the collection. They were obtained in May, 1911, by Dr. J. Coggin Brown of the Geological Survey of India. Of the 5 specimens 4 are females full of eggs which are of a large size, each being a little over a millimeter in diameter. The rounded and tapering head, the small and compact fins and the general facies of the species indicate that it is adapted to a burrowing mode of life. Moreover all the specimens are covered with a brownish mud which lends further support to its burrowing habits. There can be no doubt that *Nemuchilus acuticephalus* is not an inhabitant of swift currents and even if it frequents such habitats it probably lives burrowed in sand or among shingles at the bottom of the stream.

Measurements in millimetres.

| | ♀ | ♀ | ♀ |
|---|------|------|------|
| Total length including caudal | 40.0 | 39.0 | 36.0 |
| Length of caudal | 6.7 | 7.0 | 6.5 |
| Length of head | 6.7 | 7.0 | 6.3 |
| Depth of body | 6.0 | 6.0 | 5.0 |
| Length of snout | 2.8 | 2.8 | 2.5 |
| Interorbital distance | 2.0 | 2.1 | 1.8 |
| Length of caudal peduncle | 4.3 | 3.6 | 4.0 |
| Least height of caudal peduncle | 3.5 | 3.0 | 3.0 |
| Length of pectoral | 6.0 | 5.2 | 5.0 |
| Length of ventral | 5.3 | 5.0 | 4.7 |

***Nemachilus paucifasciatus*, sp. nov.**

(Plate XV, figs. 1, 2.)

D. 3/6-7; P. 1/7; V. 1/5; A. 3/5.

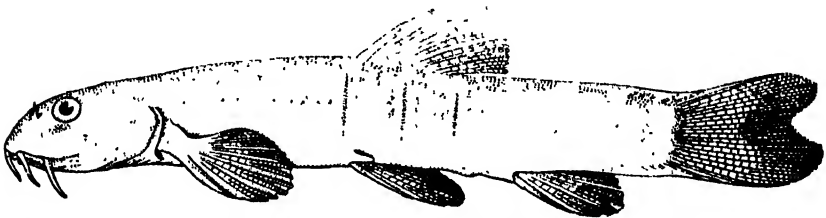
In *Nemachilus paucifasciatus* the head is depressed and the ventral surface is flat. The anterior part of the body is also somewhat depressed, but the posterior part is greatly compressed. Both the dorsal and the ventral profiles are slightly arched.

The head is broad and spatulate, its breadth equals the length of the head behind the anterior nostril and its height equals the postorbital portion of the head. The length of the head is contained from 4.2 to 4.6 times and the depth of the body 6.4 to 8 times in the length without the caudal. The eye is small and is situated nearer to the tip of the snout than to the posterior margin of the operculum; its diameter is contained from 5 to 7 times in the length of the head. The eye is not visible from the ventral surface. The nostrils are situated close together and are placed much nearer to the eye than to the tip of the snout. The membrane between the two nostrils is produced into a small, blunt projection. The three pairs of barbels are well-developed; the inner rostrals just extend as far as the nasal openings, the outer rostrals extend

to below the middle of the eyes and the maxillary barbels are slightly longer than the outer rostrals. The mouth is situated on the ventral surface slightly behind the tip of the snout. It is bordered by thick and crenulated lips which are continuous at the angles of the mouth; the lower lip is divided in the middle. For the greater part of their lengths the lips are free from the jaws, which are covered with a horny substance. In older specimens the upper jaw is produced into a beak-like process in the middle and the lower jaw is grooved in the corresponding position for its reception. Behind the lower lip the skin is raised into a pad-like structure which probably serves as an adhesive device. There are open pores on the head arranged in definite rows. Those above and below the eyes and across the nape are continued into the lateral line, while the row on the pre-opercular and inter-opercular border ends abruptly on the side of the head.

There are small, inconspicuous scales on the body specially in its posterior half. The lateral line is fairly distinct up to the base of the ventral fin, beyond which it is absent.

The dorsal fin originates opposite the ventral and its commencement is nearer to the base of the caudal than to the tip of the snout. The height of the dorsal fin is less than the length of the head. The anal fin is not as high as the dorsal and its commencement is midway between the origin of the ventral and the base of the caudal; it does not extend as far back as the caudal fin and is considerably removed from the anal opening. The pectoral is shorter than the head and is separated from the ventral by a distance almost equal to its own length. The ventral fin is slightly shorter than the pectoral and bears a short fleshy appendage at its base; in young examples it just reaches the anal-opening but in older specimens it does not extend so far back. The caudal fin is shorter than the head and is notched at the end; both the lobes are rounded. The caudal peduncle is stout and in adult specimens it is almost as high as long.



TEXT-FIG. 3.—A young specimen of *Nemachilus paucifasciatus*, sp. nov.: lateral view to show the primary colouration with indications of the bars which are so characteristic of the adult examples.

The colour varies considerably in the young and grown-up specimens. In young examples there are about 8 broad, gray bands running from the dorsal surface to the sides; these bands are separated by dull-white, narrow interspaces. A dark band of a deep colour is invariably present at the base of the caudal fin. The dorsal surface of the head is dusky. The cheeks and the ventral surface of the head and body are pale olivaceous. A dark spot is present at the commencement of the dorsal fin. With the growth of the fish the broad bands on the

body gradually fade away and the fish takes up a uniform reddish-brown tint. In the middle of the body, in the region of the interspaces, there appear narrow vertical bars of a deep reddish-brown colour. There are usually 3 or 4 such bars and they impart a very characteristic colouration to the fish. The colour band at the base of the caudal does not undergo any change and the fins do not show any markings.

Type-specimen.—F $\frac{6314}{1}$, Zoological Survey of India, Calcutta (*Ind. Mus.*).

Locality.—Hwe-gna-sang River, in the Pazi Township, of the Mong-long Sub-division of Hsipaw State, Northern Shan States, Burma.

Remarks.—There are 15 specimens of this species in the collection. They were obtained by Dr. J. Coggin Brown of the Geological Survey of India in May, 1911. The adult specimens of *Nemachilus paucifasciatus* can be readily distinguished by their very characteristic colour.

Measurements in millimetres.

| | | | | | | | | |
|---------------------------------|---|---|------|------|------|------|------|------|
| Total length including caudal | . | . | 66.0 | 56.5 | 53.6 | 48.0 | 40.6 | 39.0 |
| Length of caudal | . | . | 11.7 | 9.2 | 9.5 | 8.2 | 7.0 | 6.8 |
| Length of head | . | . | 12.0 | 10.2 | 9.7 | 9.0 | 8.0 | 7.5 |
| Depth of body | . | . | 8.6 | 5.9 | 6.6 | 5.5 | 4.8 | 5.0 |
| Length of snout | . | . | 4.3 | 4.0 | 4.2 | 3.5 | 3.0 | 3.0 |
| Diameter of eye | . | . | 1.8 | 2.0 | 1.4 | 1.6 | 1.6 | 1.5 |
| Interorbital distance | . | . | 3.3 | 2.3 | 2.6 | 2.4 | 2.1 | 1.6 |
| Length of caudal peduncle | . | . | 8.8 | 7.0 | 7.3 | 6.3 | 4.8 | 5.8 |
| Least height of caudal peduncle | . | . | 7.8 | 4.9 | 4.8 | 4.8 | 4.0 | 3.8 |

***Nemachilus raoe*, sp. nov.**

(Plate XV, figs. 7, 8.)

D. 4/9; P. 1/10; V. 1/7; A. 3/6.

Nemachilus raoe is a small and slender species resembling *N. brunneanus* both in its general facies and in its body markings. The head and the anterior part of the body are somewhat depressed and the ventral surface is flattened. The tail is compressed.

The head is proportionately larger in young specimens, its length being contained 4 to 4.3 times in the total length without the caudal. The depth of the body is much less than the length of the head and is contained 5.1 to 6 times in the total length without the caudal. The eye is situated almost in the middle of the length of the head or somewhat in the posterior half; its diameter is contained 3.9 to 4.3 times in the length of the head. The eyes become proportionately larger with the growth of the fish, a rather unusual occurrence. The snout is considerably longer than the diameter of the orbit but the interorbital width is only slightly longer than the diameter of the eye. The eye is not visible from the ventral surface. The nostrils are situated close together and are much nearer to the eye than to the tip of the snout. The anterior nostril is somewhat tubular; the tube is produced posteriorly into a flap-like projection. The three pairs of barbels are well-marked, the inner rostrals extend to the nostrils, the outer rostrals to the eyes and the maxillaries, which are as long as the outer rostrals, extend slightly beyond the eye. The mouth is on the ventral surface, slightly behind the tip of the snout and is bordered by thick lips which

are continuous at the angles, the lower lip is papillated and corrugated and is interrupted in the middle line.

The scales are rudimentary and the body appears to be naked. The lateral line is incomplete and terminates in most cases opposite the commencement of the dorsal.

The dorsal fin is almost as high as or higher than the length of the head; it originates in advance of the ventral and its commencement is either equidistant between the tip of the snout and the base of the caudal or is nearer to the former than to the latter. The pectoral fins are longer than the head, are pointed in the middle and are separated from the ventrals by a short distance. The ventrals are much shorter than the pectorals and reach the anal opening; they are provided with fleshy appendages at their bases. The anal fin is much shorter than the dorsal and just reaches the base of the caudal fin. The caudal fin is longer than the head and is deeply forked in the last third of its length, the upper lobe is better developed than the lower. The least height of the caudal peduncle is contained 1.1 to 1.2 times in its length.

The ground colour of the head and body is pale olivaceous. The dorsal surface of the head is mottled and spotted with black. The body is marked with about 22 dark horizontal bars on the sides separated from one another by narrow interspaces. At the base of the caudal fin there are two deeply coloured short black bars on each side of the caudal peduncle. There is a black blotch at the base of the dorsal fin in front and a row of short black lines across its middle. The caudal fin is indistinctly marked in its proximal half with two or three V-shaped dark bands. The other fins are white. The outer rostral is finely dotted with black.

Type-specimen.—F $\frac{11062}{1}$, Zoological Survey of India, Calcutta (*Ind. Mus.*).

Locality.—Mongyai, N. Shan States, Burma.

Remarks.—Drs. H. S. Rao and B. N. Chopra collected six specimens of this species from a large tank full of weeds near the Inspection Bungalow at Mongyai. *N. raoe*, like its nearest ally *N. brunneanus* from the S. Shan States, is an inhabitant of sluggish waters, and it seems probable that the markings on the body adapt these species to life among weeds (protective colouration). *N. brunneanus* differs from the new species in having larger eyes, a larger and narrower caudal peduncle and in having the entire body covered with distinct scales. There are also differences in the colouration of the caudal and the dorsal fins of the two species.

Measurements in millimetres.

| | | | | | | |
|---------------------------------|---|---|---|------|------|------|
| Total length including caudal | . | . | . | 42.4 | 39.4 | 35.8 |
| Length of caudal | . | . | . | 8.9 | 8.8 | 8.0 |
| Length of head | . | . | . | 7.8 | 7.5 | 7.0 |
| Depth of body | . | . | . | 5.6 | 5.8 | 5.4 |
| Length of snout | . | . | . | 3.2 | 2.8 | 3.0 |
| Diameter of eye | . | . | . | 2.0 | 1.8 | 1.6 |
| Interorbital distance | . | . | . | 2.2 | 2.1 | 2.0 |
| Length of caudal peduncle | . | . | . | 5.8 | 4.1 | 4.0 |
| Least height of caudal peduncle | . | . | . | 4.7 | 3.8 | 3.4 |
| Length of pectoral | . | . | . | 9.0 | 8.1 | 7.4 |
| Length of ventral | . | . | . | 6.5 | 6.2 | 5.2 |

Nemachilus brunneanus Annandale.

(Plate XV, fig. 9.)

1918. *Nemachilus brunneanus*, Annandale, *Rec. Ind. Mus.* XIV, p. 44, pl. ii, fig. 2.

Annandale described this slender species from the Yawngwe Valley and remarked that "this little loach is abundant in the waters of the Yawngwe valley and seems to be equally at home in clear hill-streams, in muddy rivers and among the weed-thickets of the Inlé Lake, in which it occurs both in the central region and in the marginal zone". I have examined Annandale's material and find that the single specimen collected by him from the Hsin Daung Chaung stream has been erroneously referred to *N. brunneanus*; it belongs to my new species—*N. rivulicola*. *Nemachilus brunneanus* is an inhabitant of sluggish waters; its large eyes, complete lepidosis, long and pointed paired fins and the lateral line restricted to a short distance are some of its salient features.

Measurements in millimetres.

| | | | | |
|---|------|------|------|------|
| Total length including caudal | 46.7 | 45.0 | 44.6 | 42.0 |
| Length of caudal | 9.0 | 9.0 | 9.5 | 8.5 |
| Length of head | 8.0 | 8.7 | 8.3 | 7.5 |
| Depth of body | 7.2 | 7.2 | 7.0 | 6.8 |
| Length of snout | 2.8 | 3.3 | 3.0 | 2.6 |
| Diameter of eye | 2.5 | 2.5 | 2.6 | 2.5 |
| Interorbital distance | 1.8 | 2.0 | 1.3 | 1.7 |
| Length of caudal peduncle | 5.6 | 5.5 | 6.0 | 5.0 |
| Least height of caudal peduncle | 3.2 | 3.6 | 3.7 | 3.2 |
| Length of pectoral | 9.2 | 9.0 | 9.3 | 8.6 |
| Length of ventral | 6.2 | 6.3 | 6.4 | 5.6 |

EXPLANATION OF PLATE XIV.

Nemachilus peguensis, sp. nov.

- FIG. 1.—Lateral view of type-specimen, $\times 1\frac{1}{2}$.
,, 2.—Ventral surface of head and anterior region of body of same,
 $\times 2\frac{1}{2}$.

Nemachilus cinclicauda (Blyth).

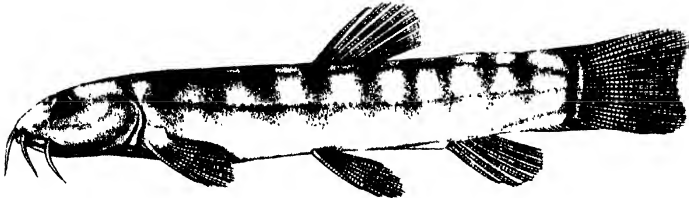
- FIG. 3.—Lateral view, $\times 2\frac{1}{2}$.
,, 4.—Ventral surface of head and anterior region of body, $\times 3$.

Nemachilus acuticephalus, sp. nov.

- FIG. 5.—Lateral view of type-specimen, $\times 3$.
,, 6.—Ventral surface of head and anterior region of body of same,
 $\times 4$.



1



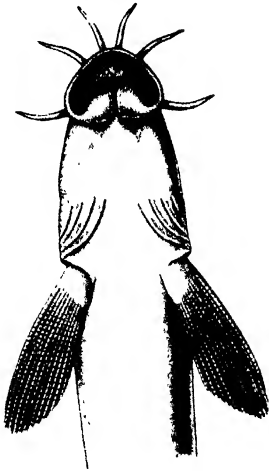
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2



4

S. O. Moudul & D. Bagchi, del.

Nemachilus from Burma.

EXPLANATION OF PLATE XV.

Nemachilus paucifasciatus, sp. nov.

FIG. 1.—Lateral view of type-specimen, $\times 2\frac{2}{5}$.

„ 2.—Ventral surface of head and anterior region of body of same,
 $\times 1\frac{3}{5}$.

Nemachilus rivulicola, sp. nov.

FIG. 3.—Lateral view of type-specimen, $\times 1\frac{3}{5}$.

„ 4.—Ventral surface of head and anterior region of body of same,
 $\times 1\frac{3}{5}$.

Nemachilus shanensis, sp. nov.

FIG. 5.—Lateral view of type-specimen, $\times 1\frac{3}{5}$.

„ 6.—Ventral surface of head and anterior region of body of same,
 $\times 1\frac{3}{5}$.

Nemachilus raoe, sp. nov.

FIG. 7.—Lateral view of type-specimen, $\times 2\frac{2}{5}$.

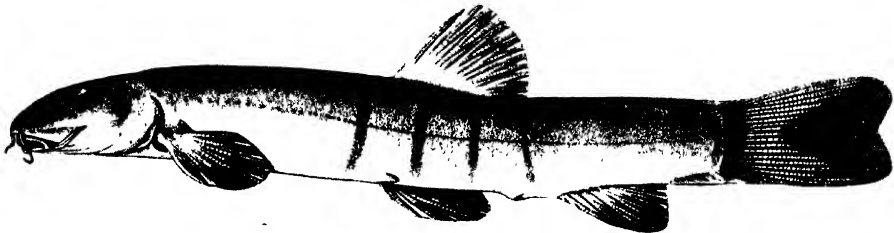
„ 8.—Ventral surface of head and anterior region of body of same,
 $\times 3\frac{1}{5}$.

Nemachilus brunneanus Annandale.

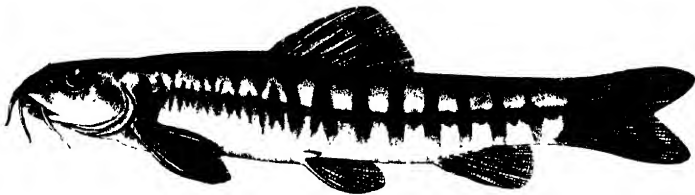
FIG. 9.—Ventral surface of head and anterior region of body, $\times 1\frac{3}{5}$.

Nemachilus brevis Boulenger.

FIG. 10.—Ventral surface of head, $\times 3\frac{1}{5}$.



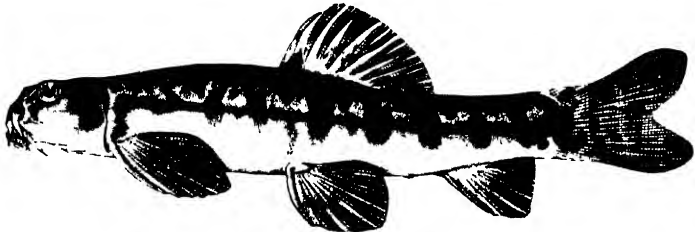
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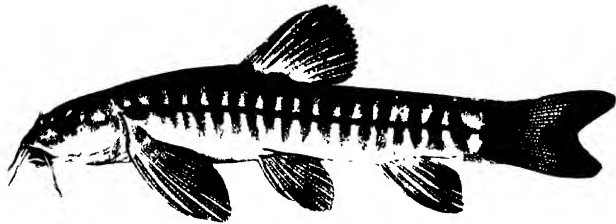
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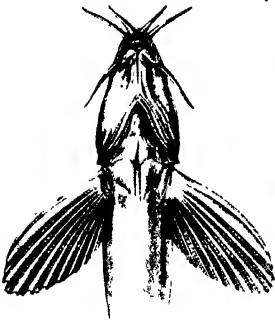
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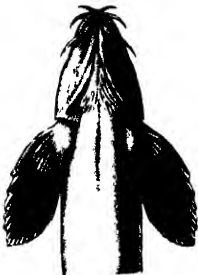
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6

D. Bagchi del.

Nemachilus from Burma.

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Appendix.



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LIST OF LITERATURE REFERRING TO INDIAN ZOOLOGY (EXCLUDING INSECTA) RECEIVED IN CALCUTTA DURING THE YEAR 1929.

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[N.B.—An asterisk (*) preceding a line denotes a new variety or subspecies; a dagger (†) indicates a new species; a double dagger (‡) a new genus or subgenus; a double asterisk (**) a new family or sub-family: synonyms are printed in *italics*.]

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